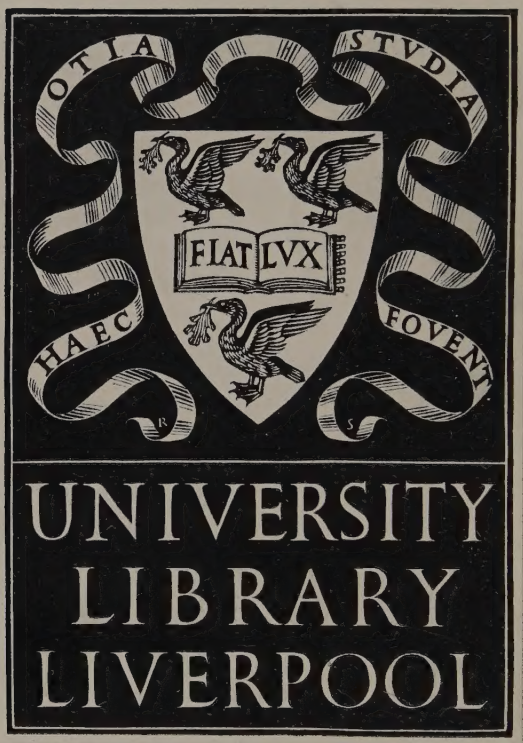

CHILDREN AS NATURALISTS

Frontispiece

Photograph, Phyllis M. Bond

*Feeding the Owlet Tootles*

See Chapter V.

# CHILDREN AS NATURALISTS

*by*

*Margaret M. Hutchinson*

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# INTRODUCTION

WHEN I CONSIDER my childhood, I realize that it was not what I learnt in the nature lesson, but what I gleaned from the hedges and woods and ponds that stuck, and gave me a life-long passion for wild life.

So when I started a school of my own, I determined to create, as far as possible, opportunities for the children to find out for themselves those things I had enjoyed discovering, and to avoid the classroom atmosphere of "learn this, learn that, write neatly, draw accurately," that had been so irksome to me and left me almost invariably at the bottom of the class.

Not that I do not believe wholeheartedly that neatness and method and clear, accurate diagrams are an essential part of scientific training, but with children I am sure it is the wrong approach. First kindle their enthusiasm, and the rest comes automatically if they have any scientific bent at all; and if they have not, you have at least aroused in them that appreciation of the beauty and wonder of wild nature which lies hidden in most people.

Part One of this little book deals largely with the scope of work which may be touched upon, and the attitude adopted in different age groups throughout the junior school, when they are turned loose and learn their nature study out of doors. It must be emphasized, however, that no hard and fast line between these groups may be drawn. The children's interest is what matters, and the last thing I should wish is that anyone should try to follow these chapters as schemes of work. It is assumed that nature study is taught in the junior school, and that it gives place to biology in the senior school. Nevertheless much that appears in the following pages may well be applied to children over eleven years.

Part Two deals in more detail with different aspects of nature study and attempts to answer briefly for the teacher a

few of the many questions raised on a nature ramble and which are not to be found in the popular books on the subject. If somewhat reminiscent and full of examples from my own school I make no apology. I can only write about the children I know. If I make those who teach in the cities envious, I am truly sorry. I feel very strongly that the country is the child's natural heritage. It ought to be possible soon for every child to spend at least a few weeks each year in the country, in which case perhaps even the teacher of the town school may find something here to encourage and help her.

Finally, I wish to make a grateful acknowledgment to the Editor of *School Nature Study* (the publication of the School Nature Study Union) for permission to revise and use again the following articles "The Study of Insects with Junior School Children" and "The Study of Fungi with Young Children"; also to Miss P. M. Bond for kindly supplying the photograph for the frontispiece.

# FOREWORD

MISS HUTCHINSON'S VALUABLE book should be widely read by teachers of children under eleven, and by others who like the country and the young. It is a detailed account of what can be achieved in the domain of nature study with young children at school. It describes the ground covered and the methods used by the author with her own pupils, and it includes many practical hints about the making of apparatus, as well as some of the scientific information needed by the teacher but not easily found in elementary text books.

It should be remembered that the circumstances in which Miss Hutchinson works are exceptional. Her classes are small, the school has large and very beautiful and varied grounds, and she herself is a scientifically trained and passionately enthusiastic naturalist.

This conjunction of favourable conditions probably means that an unusual level of interest, knowledge, and of maturity of thought has been reached among her children. It would be dangerous to try to instil that amount of knowledge if the other two factors were lacking. It could only be done by unwise pressure. Miss Hutchinson recognizes this and herself insists that the interest must not be forced, and that the scientific load must not be more than the children want to bear. There has been far too much of such forcing in the past; so much so, that many educationists cannot now endure the thought of letting any subject teachers near junior school children, lest these should still be kept . . . eyeless in Gaza, at the mill with specialists.

There is no doubt, however, that intelligent young children have genuine and sometimes strong scientific interests, as well as delight in natural beauty. Any teacher who lets her children be free has seen the spontaneous expression of both, as I have seen it in Yafflesmead School. How far the children can go

with real profit to themselves, and how much guidance they should be given, are still matters needing further research, based on many experiments with different kinds of groups in different settings. The natural history of the child is an important part of the problem to whose solution Miss Hutchinson contributes with such authority, clarity and humour.

EVELYN LAWRENCE, B.Sc., Ph.D.

*Director, National Froebel Foundation.*

TO
PHYLLIS

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## Part One



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# ILLUSTRATIONS

*With the exception of the frontispiece, photographs are by the author.*



# IN THE TEXT

# PART ONE

CHAPTER I

# *Exploring with the Kindergarten*

TURN A GROUP of four-to six-year-old children loose in a rough meadow on a Summer's day. What do they do? Some jump and skip about over the ant-hills, some pick flowers, others chase butterflies, and others again "nose about" and discover all sorts of tiny treasures—a snail shell, a puff-ball, a caterpillar, or a feather. But sooner or later most of them will be gathering flowers, keeping up a lively commentary and discussion all the while. They are blissfully happy, being free to join with others or go their own sweet way, and entirely unhurried. They ask few questions beyond "What is this?" but incessantly run to you with the exclamation, "See what I've found!" Frequently their finds are of little obvious interest, but now and then something of particular note is found, and the teacher who is "on the spot" seizes the opportunity to "expound." Several children gather round, anxious to see the latest discovery and to hear something about it—but they don't wait long! They are soon wandering off again on their own explorations. They want to be *amongst* nature all the time; of it, and with it, and enjoying it in their own particular way.

How is this state of affairs to be turned into the nature lesson? How is it to be utilized to the best advantage, so that the precious hour allotted to nature study is not wasted? It is evident that the kindergarten child is very individual. Then he must be allowed to follow his own individual bent. To allow for the bents of fifteen or twenty small children needs a considerable amount of room! Then take the children somewhere they can safely "spread out." In these days of dangerous

roads, our small children are apt to be very much restricted and looked after. There is nowhere save their own gardens and the school playground where they can wander safely. So for their nature lesson find, if possible, a large space—a field, common, wood or park, and they will be content to visit the same place over and over again. Most of the nature periods in a certain Summer term were spent in a rough meadow bordering the school garden, and not once did the children suggest that they were tired of that field and would like to go somewhere else.

And what did we find there? Let's ask the children. Flowers —little odd flowers that we had not noticed before. We all knew bluebells and primroses, buttercups and daisies, but here were funny little flowers with strange names: milkwort, tormentil, silverweed, speedwell, mouse-eared hawkweed, ladies slipper. We were told the names and we practised them often, and some we remembered but many we forgot. But we *did* like the flowers!

And down on the bank near the stream were some spotted orchids; it was rather a scramble to find them, for there weren't very many and not always enough to go round. And down there too grew ragged robin and water forget-me-not, and right in the boggy stream one day we saw the yellow flag. None of us could reach it, but it was picked for us and we put it in water in the classroom. And there was a bush in the field, a very prickly one—and one day it was covered all over with white roses! And the bees from the hive in the school garden were ever so busy amongst them. We could see the pollen bags on their legs, all fat and yellow. We tried to pick some roses but they wouldn't come, so we were each given one and we took them back to the classroom and put them together in a bowl.

And what did we do with all the funny little flowers we found? We only picked a few of them of course; there were lots and lots left. Those we picked, we took back to the classroom, and sometimes we put each kind in a separate little pot

and tried to say their names when we came to school next day, and sometimes we put them altogether in a vase, just to see how jolly the colours looked all mixed up.

And later in the Summer, we found all sorts of creepy-crawly creatures. There were spiders, of course, and though some of us don't like spiders, we are getting quite brave about them because we've seen so many. And we found a spider's home, a white silky ball in the grass, and when someone touched it all the baby spiders came out! We like baby things —even baby spiders!

Then there was that bubbly stuff called cuckoo-spit. It's nothing to do with cuckoos really, because we looked inside and saw the little green insect that blew all the bubbles to make his bubbly house.

There were *lots* of grasshoppers in the field, and they used to jump out from under our feet and make us jump too! They were awfully difficult to catch but some of us got quite clever at it. Then we would open our hands and watch them jump off into the grass again.

One day we found a six-spotted burnet moth. We counted the spots and there *were* six, only two were smudged together. And we found a second one, a poor thing with its wings all crumpled up. And nearby was the little case out of which it had just come. No wonder its wings were so crumpled if it had come out of so small a house! We picked the piece of dead grass on which the cocoon was fastened and carried it back to remember it by because the moth won't want it any more. And Sally got the burnet moth to walk on her hand, and it seemed to like it, for it stayed there all the way back to school. And then we noticed that its wings weren't nearly so crumpled, and it tried to fly, but it only flopped on to the floor. So we picked it up again and carried it out of doors so that it could fly away if it liked, and soon its wings were quite unfolded and we could see all its spots—six of them. Then it flew away and we never saw it any more!

Next time we went to our field we found another moth, rather like the burnet, only it had a red line along the front wings. It was a cinnabar; and we looked on the ragwort which was in flower then and found lots of tiny cinnabar caterpillars —some were ever so wee!—and they were striped black and yellow. And we were told that when they grew bigger they would go to sleep in cocoons all the Winter and next year they would wake up and fly about like the cinnabar moth is doing now.

The above description from the child's point of view gives the kind of thing that is enjoyed, the amount of study (not very much!) given to an object, and the amount of help and suggestion offered by the teacher. It is obvious that some effort was made to encourage the children to learn the names of the flowers. Here is one of the advantages to be gained in visiting the same spot each week, for it gives ample opportunity for revision. The names of the moths were learnt and the difference in appearance between them pointed out. The relation between caterpillar, cocoon, and moth were also pointed out, but not emphasized, and no effort was made to establish in the child's mind the whole life-history.

Watching the life-history belongs better to the next stage—the seven and eight-year-olds, whose interest is more sustained and who are more capable of looking after their caterpillars. But the appetite for knowledge of these things is whetted in the kindergarten.

An open woodland glade affords much pleasure to the small child. Here may be found in May or early June many creeping plants, and the foundations are laid in the child's mind that plants are living, growing things, needing light and air just as much as we do, and seeking to fulfil their needs in their own particular ways. Let the children follow with their fingers the stem of a yellow pimpernel from the tip back to the root-stock and having found this (the "middle" of the plant) let them

1. *They Want to be Amongst Nature*
A Kindergarten Ramble

follow out along other runners of the same plant. They will be surprised at the large size of the plant, although the flowers are so small. There will be other plants crossing the runners: violet, bugle, trailing St. John's wort, stitchwort, ground ivy, speedwell, and perhaps the dainty wood sorrel. Children love small details and will enjoy peering into their woodland flowers—"looking into their faces." They will see dainty red veins on the wood sorrel petals, a little red knob in the centre of the bird's-eye speedwell (the stigma), a seed box which pops when squeezed, on dead stitchworts, and inside little white seeds like tiny eggs. Show them the inside of a foxglove flower (and don't forget that foxglove means folk's glove, and folk are the *fairy* folk); let them see the pathway of spots to show the bees where the honey is hidden, and the row of hairs to keep away tiny insects.

Do not lay too much stress on such explanations however. The intricacies of pollination very quickly become too involved for the small child to grasp. But the important factor in all this is to teach the child to *look*, and to look closely. In this way a fund of observations will be stored up "at the back of the mind," for future reference and interpretation.

The same woodland in Autumn brings fresh delights. Then the children should be allowed to gather nuts, acorns and crab apples to their hearts' content. But before going home ask what they intend to do with these treasures. They will probably have no idea. Then suggest that there are little woodland animals, the squirrels, mice, and rabbits who regard these things as their daily food. Nibbled apples, broken nut shells, empty acorn husks, all tell us that the animals have been there. So it would really be the kindest thing to leave most of our treasures for them. We pick out the fattest acorns to grow indoors and the rosiest crabs to keep in our treasure bowl and the rest we scatter in the leaves again. What a good thing it is that little children, who are such keen collectors, seldom mind

throwing down their treasures again if an attractive reason for doing so is put before them.

Autumn is the best time for starting the study of trees, and this may well be begun in the kindergarten but again should not be over-emphasized. The leaves of the more common trees—oak, beech, ash, birch, hazel, and whitebeam—are easily learnt, and their fruits also. The bark of oak, beech, and birch can be distinguished though the others are not so easily recognized.

A game may be played to encourage quick recognition. The children stand in a ring round the teacher. When she calls the name of a tree, they run and touch that tree. No two children may be at the same tree. If the class is large they may play in couples. Variations of this game include fetching a leaf from a given tree. The first child back takes the place of the teacher and calls the name of the next tree. A third variation is to bring back anything connected with the tree—a piece of dead bark, a fruit or twig; or bringing two of them.

But so long as the children are happily and concentratedly engaged in searching, I would not foist games on to them. There will be many other things to find in the wood in Autumn besides leaves and fruits. Toadstools are terribly attractive, but many adults will doubt the wisdom of allowing small children to pick them on account of their poisonous properties. If they are picked, it should be with great restraint. The children should be taught to distinguish between the fresh young ones and the old shrivelled or maggotty ones. Only a few choice specimens should be gathered and these put into a basket carried by the teacher.

Chapter X is devoted to the study of fungi and though much of it is intended for older children, beginnings may be made with the kindergarten if they show interest in the subject.

And what of the Winter lessons? Then, I admit, it is not so easy to let the children roam over meadows and in the woods, where it may be very damp and often too cold to loiter. But

I still hold that, whenever possible, the children should spend their nature lesson out of doors, if only for the sake of their own health. When you realize that the child spends nearly all the morning in the classroom, and the first part of the afternoon either in school again or resting, quite the best part of the short Winter day has gone before he is able to play in the garden or go for a walk. So in the kindergarten every opportunity should be taken to get some part of each morning out of doors for games or nature ramble or both. If it is possible to make the time-table sufficiently elastic to seize the first sunny day in the week for the nature day, so much the better. If it is not, then there is nothing to do but to "pray for a fine day."

The end of the Autumn term may well be spent in the woods still, even though it may be necessary to keep to the paths, for there is a great fascination about trees that have just lost their leaves. If it is possible to take the children out to a hill from which they look down on the tops of the trees below, what a change they will see from September, when all is heavy green, to October when the trees are flaming orange and gold, and again in December when they are all bare and grey! The children might now collect twigs of the few trees they are learning to recognize, and will be fascinated, if a little incredulous, at the idea that in the buds (little fat oak buds, and long sharp beech buds that almost prick your finger), lies the potential glory of next year's foliage. The buds collected (and don't forget to include the sticky buds of the horse chestnut) should be kept in water together, and the water changed at least once a week. At the same time the twigs should be dipped into cool refreshing water to wash off any dust, as the rain would do for them if they were still on the tree.

December is a good time for studying evergreen trees, holly and fir in particular, owing to their association with Christmas. Fir-cones may be collected—this is an excellent

occupation for the not too cold day—and given away to some old lady who would like to burn them in her fire but who cannot go out to gather them herself. While gathering fir-cones, some may be found from which the scales have been torn, leaving only the central core, telling us that a squirrel has been enjoying a feast. And if we open a fairly ripe cone we may see the seeds on which he likes to feed, each one with a wing to help it to blow away when it is time for it to leave the cone and grow up into a new fir tree.

It is the first two months of the Spring term, January and February, that are perhaps the most difficult to fill up profitably with out-of-doors nature study. Then may come bitter, icy days when nothing less than a brisk run will warm the toes. So have a run! Run to some favourite spot, the firwood, perhaps, to see what it looks like in the frost; or the common to see if there are any flowers on the gorse yet. Spend a few minutes admiring the work of Jack Frost among the dead leaves or the bracken, and then run home again! It is in weather such as this that we are most careful to remember the birds. A story illustrating the hardships of the birds in winter time might be told to arouse sympathy and understanding, and then the children can undertake to feed the birds each morning, either on their window-sill or on a bird table within view of the window, not forgetting also to put a bowl of water out, and to keep it free from ice. Then some time should be devoted (it might be half the nature lesson if the weather is very unappetizing) to sitting near the window and learning the names of the birds that come. A few tags to help the memory or stir the imagination are useful, for instance: the black bib of the cock house-sparrow, the blue beret of the blue tit, the smart black tie and yellow waistcoat of the great tit, the pink stockings of the hedge-sparrow. Others will be suggested by the children themselves.

Interest in birds is easily aroused, and the next fine day may well be spent on a ramble to a field. If possible, select a field

with a fence through which the children can see easily without going in. Here they might count the birds they see on the ground. It may be only blackbirds and thrushes, it may be also starlings, rooks, jackdaws, and even peewits and gulls. Learning to recognize these by their colours and size—often very difficult to determine accurately in the field—is one useful occupation, and finding out what they are doing, and how, is another and more suitable one. Remember that children at this age are far more interested in what an animal *does* than what it is called.

Watch the birds that walk, and those that hop, and let the children imitate them if they can do so without frightening the birds away. Notice if they like to keep together in flocks or small parties, or whether they prefer to be alone—do they talk to each other or are they too busy feeding? How do they feed? If there are rooks about it will probably be possible to see them probing in the ground with their strong beaks. When they bring their beaks up again they will look muddy and there will be a ridge of mud on their faces. What a good thing it is then, that rooks have no feathers on the front part of their faces, as the bare skin is obviously much easier to clean, just as our faces are easier to wash than our hair. Blackbirds will be noticed scratching up dead leaves under the hedge and making a rustly noise about it. They are finding all sorts of little insects that have gone to hide there for the Winter.

On another Winter's day a visit might be made to hay or straw ricks where flocks of finches may be seen feeding on scattered seeds. These are rather small birds to identify in the field, but probably the chaffinch and house-sparrow will be hailed as old friends of the bird table, and the fat greenfinch will be learnt by his colour if seen in a good light. But here again it is far more important to see what they are doing. There are two erroneous ideas current among children (I have found them among quite big girls) which will be best corrected by making some such observations as those just

described. One is that all birds feed on worms and the other is that all the birds feed on seed. The former mistake has its origin in the everyday occurrence of thrushes, blackbirds, and robins pecking on the lawn, while the latter probably comes from those who keep canaries.

By now we are getting towards the end of Winter, and there will be days even in February when Spring flowers may be found—daisies, chickweed, celandine, an early dandelion, and hazel catkins.

An excursion to a sheltered part of the wood may reveal quite a number of primroses—little short-stemmed flowers peeping out from the carpet of dead leaves, but more precious than the wealth of larger flowers we shall gather later on, for each needs hunting for, and keeping carefully, and persuading to stand up in the moss-covered plate in the classroom.

And so we come round once more to warmer days, when we are able to potter about our woodland glades again, each on his own bent, without being hurried in order to keep warm. Now it's a twig bursting with green, now a bluebell shoot pierced right through a dead leaf, now it's an early nest—we're searching, searching often we know not for what, but it's sure to be interesting when we find it!

I have tried to give a rough sketch of the possibilities for out-of-doors nature study round the year for the four- to six-year-olds. It can only be a hint as to how it may be tackled. The number and type of children, and above all, the type of country available, vary so much that it is impossible to do more than point the way. In any case it would be unwise to do more than this, as it would spoil the spontaneity of the nature ramble—we want the children to feel that they and the teacher are doing the searching, not that the teacher is taking them on a tour of the sights. That they much prefer to be the searchers is shown in the reluctance with which they leave their activities to listen to your narrative! But the teacher has a very vital

part to play. She must be ready to admire. She must be ready to answer questions, even if it is only: "I don't know. We must look it up in the book when we get back." She must be ready to explain to a certain extent some of the more curious things that are found. She must constantly seize opportunities of revision, of rubbing in knowledge and adapting it in the light of new experience. All this needs a fairly wide knowledge, if not a very deep one, of the countryside, and it is best sought in the fields with the aid of a few reference books at home. She must also watch the children, and try to arouse interest in anyone whose natural curiosity is only faintly glimmering. She must try to find what particular things attract particular children, and whether anything is repellent to any child. Some children are very much afraid of spiders, but this fear is more easily overcome at this age than later on. The child needs confidence and knowledge. If, when a group of children are poring over a spider's nest, the teacher talks interestingly about spiders and their babies, the while holding the nervous child by the hand, both to include him, and to give him confidence, that fear will be largely overcome by the interest aroused. Some bold child will like to touch the spider, and, seeing that no harm comes, the nervous one may be persuaded to do the same. But on no account should he be pressed to do so against his will, or made to feel he is a coward for refraining. Leave it till another opportunity occurs.

Some children, particularly those brought up in the town, are nervous of the woods, and of the animals that live therein —the foxes, badgers, and deer. When I know there are such children in the class, I emphasize again and again the harmlessness of such creatures and the fact that they are much more afraid of us than we are of them! But these fears are apt to linger unless the teacher regularly takes steps to shield the child (without letting him know, of course), by keeping him near her and by keeping up a bright conversation about the things they are looking for. It is most important that the

nervous child should never get left behind, even by a few yards, when in the woods. The feeling of loneliness can be quite acute and sudden, and the child soon feels lost even though the others are within hearing. I always think of Kenneth Grahame's wonderful description of "the wild wood," and the effect it had on Mole. This is just the effect it has on the "lost" child.

I remember one such child, a girl between six and seven years, who was full of these fears, and difficult to help because she bravely tried to hide them, with the result that they were apt to crop up in nightmares and other nervous disturbances. One day we had been to visit a badger's earth and had, in the course of our wanderings, come upon the scent of a fox which led us also to his den. The class (Form I this time, not kindergarten) were tremendously excited and interested, but Josy slipped her hand into mine and said in the most matter-of-fact tone she could assume: Miss ——, you *did* say, didn't you, that foxes always run away from people?" Years later she told me that she had, in those early days, confused foxes and wolves!

The most important part of the teacher's work is to inculcate in the children the right attitude towards nature. This is largely done by example and gentle reminders. There must be no wanton destruction of plant life, and some education is necessary in the matter of what may be picked and what may not. I know a small child who, from the time she could first walk, had a passion for flowers. She trotted out into Grandma's garden one day in early Spring and returned clutching a fist full of crumpled crocuses. How hard it was to teach her not to pick Grandma's flowers! She did so love them, and the natural consequence of loving them was to have them. She *did* learn after several mistakes, to pick the daisies from Grandma's lawn but to leave the crocuses growing on the edge. She *did* learn, after a long time, a certain respect for other people's conventions, but it was hard always to resist the temptation of a bright, new flower. One day when she was

four years old, she picked a very precious flower from the garden to put in her bouquet. When reprimanded, she remarked in a hurt and scornful voice, "But I did leave *one*."

Another toddler, not more than three, arrived in from the garden one day with a tulip on a stem not more than an inch long. He took it straight to Mother—it was so lovely! But Mother was rather sorry to see it and explained that it would have been better left to make the garden gay. Then together they put it into water and the small boy departed out again. A little later he came in with a second tulip—straight to Mother! Patiently she explained again that she liked to see them growing and didn't want him to pick any more. It too was put into water, and once more he went out to play. But a third time he arrived in with a tulip—and as that was the last one in the garden, there the matter ended.

These two stories illustrate the strong attraction there is for small children in bright and pretty things, and the natural desire to have and to hold such things. By the time they come to school, if not before, they can learn some discrimination and restraint in what they pick of wild as well as of garden flowers. "Let us leave some to grow their seeds so that there are more plants next year." "Let us leave plenty to make the field look lovely for other people to enjoy." "Let us leave some for other children to pick." Such remarks will do much to inculcate a spirit of unselfishness and regard both for the plants and for other people. But the children should not be restricted unnecessarily.

A little girl of five clutched a handful of undeveloped chestnuts, acorn cups and beechmast picked up on a nature ramble. Just as she was going home she pressed them into my hand, saying, "You keep them; Nanny calls them rubbish." Nothing was rubbish to that small person, whose collective instinct and powers of observation were remarkably strong. But she lacked discrimination. Through the guidance of her teacher, and the tit-bits of knowledge picked up on the

nature rambles, she became more discriminating, developing from a hoarder into a collector.

It is the development of the spirit of wonder that will do most to bring the child into the right attitude towards nature; that attitude which may well be expressed in the motto, "To see and admire; not harm and destroy." And the more of the wonders and beauties of nature the child sees, the less will he want to destroy. I do not mean by this that the teacher must be forever exclaiming loudly on the beauty of this or that; far from it! Putting before children beautiful objects, or better still, putting the children amongst beautiful things, is far more effective. Children will not very often remark on the beauty, but they do appreciate it, or "assimilate" it. I remember taking a group of children to a wood in bluebell time, where, for as far as you could see, stretched a blue carpet beneath the fresh green foliage of the chestnut trees. One little girl remarked with a sigh (it was Josy, who was so nervous of the woods) "I *would* like to bring Mummy here." There was no thought of taking the flowers to Mummy—it was the whole picture, the bluebells in their setting, which was so wonderful, even to the child mind.

The wonder of growth and movement is not so easy to "get across" to small children; they are apt to take so much for granted. But they *do* grasp some of this, and more and more of it the older they grow. It is not necessary to graft on to some natural phenomenon, magic or fairy properties, either to make it more attractive, or to explain it. Nature is quite attractive enough without these additions, and to attempt to explain her movements by them because the real explanation is beyond the grasp of the small child (and probably of us all) is entirely false and only has to be unlearnt later on. There is no harm, of course, in pretending the fairies come and dance in the Fairy Ring at night. That is a pretty child-like fancy and certainly has its place at this age; but do not tell the children that the gnomes ate little pieces out of the toadstool last night

for supper, when a little searching will reveal the real culprit—a fat slug!

Another side of the work in the kindergarten is the incidental nature which is observed by the children from time to time. It may be on a walk at home or on the way to school; the child who has his eyes open will want to tell about or show what he has seeen. Two or three times a week, at the beginning of the morning, children should be given the opportunity of thus sharing their "news" with the class. One by one they come out to the front and "do their bit." This is valuable English speech training and a social opportunity; it is a link between home and school; it encourages the shy child while giving scope to the forward and more talkative ones.

Frequently children will describe things they have found which have some connection with objects they have been examining on the nature ramble. The teacher may, through the medium of the "News" period, encourage children to look for certain things and report on them at the next "News" period. This "follow up" is particularly valuable in the older forms.

Many topics will be touched on in "News." Stories will be told of tame robins, of a bird's nest in the garden at home, of pet dogs and cats, of squirrels, and bunnies. It is not always easy to distinguish the true story from the embroidered one, or even the invention of the moment. Some children are given to flights of fancy and it is necessary, in a scientific subject particularly, to emphasize careful and accurate observation. A little girl, Marie, aged four years, always wanted to go one better than the other children in "News," and this was apt to lead her far from the truth. Moreover she was most persistent, and nothing I could say of a persuasive nature, seemed to have any effect. One day another child gave an interesting account of a visit to the Zoo. He described the parrot house, and how he had watched the seals diving for their food. This was too much for Marie.

"I seen pawots diving for their food," she remarked with a wise nod.

She had an extraordinary idea of grammar and pronunciation due probably to being of foreign birth. "Oh, Marie, I don't think so," I exclaimed, "parrots can't dive!"

"Yes, they can—the g'een ones," she persisted.

"No, Marie, not even the green ones."

"Yes, they can—in Fwance," she added. This was a great hit, as having travelled most of the Continent before ever coming to school, she felt greatly superior to the rest of us.

"But think how wet their feathers would get," I entreated desperately, remembering too late all the hosts of water-loving birds, and hoping Marie would not see through this. But she had her own answer: "They have no fevvers—not in Fwance," she replied crushingly, and here we hastily went on to the next child's news.

The same amusing little girl was taken with the rest of the class to see the footprints of a deer that had come to the edge of the garden. We were following the tracks, calling to each other as we found one after another along the path leading into the wood. Suddenly Marie stopped, and pointing dramatically into the bushes, whispered excitedly, "I seed the deer—just one horn!"

But to return to the classroom. A corner should be found for the nature table, on which the children's treasures may be exhibited for all to see. Flowers are arranged there, pictures put on the wall behind, while, tucked away in some cupboard, out of sight but within easy reach, should be an assortment of glass pots and jars, bowls and boxes without lids to serve as trays. In these, specimens are set out, and considerable pride is taken to keep the nature table dusted and tidy, and, above all, attractive.

During the Spring months a flower calendar may be kept to encourage the children to look for early flowers and to learn

their names. Any child who brings a new flower to school writes its name on the calendar with the date on which it was found, and his own initials. It it not advisable, however, to lay too much emphasis on such a chart, as there is bound to be a certain amount of competition entering into it that hardly belongs to this age. I would suggest that such a calendar be only used where interest needs stimulating, and that in a class where such interest is fully alive, it should not be tampered with by the introduction of an outside stimulus.

I mentioned earlier that small children are very fond of baby animals. It is seldom, however, possible for them to see the young of wild animals, save occasionally, birds in the nest, or ducklings and cygnets on the pond. Visits should be paid therefore, to a farm, with the object of seeing calves, foals, lambs, kids, chicks, etc. These visits may be taken in conjunction with lessons on "How we get our milk," "The work of the farmer," etc. or they may be simply nature rambles.

If it is possible to rear a brood of chicks at school, it will be of great interest to the kindergarten, but as most of the operation is too difficult for the children to do themselves, it is probably best to leave it till they are a little older, or at any rate to repeat it then.

Kindergarten children are, generally speaking, more concerned with the baby creatures as they see them, than with their birth, though some are sure to ask where they come from and this may arouse in others the same desire to know. Their questions should be truthfully answered, avoiding being either mysterious or common-place. I believe there is a great deal in the *manner* in which such questions are answered. Personally I adopt much the same tone in which I answer a question such as "What happens to cuckoos in the Winter?" Both are interesting questions and deserve interesting answers. But I avoid detail in the question of birth, unless it is requested,

which it seldom is. Nor do I think it necessary, because one child has asked a question, always to give the answer to the whole class. The discerning teacher can generally tell whether most of the children are interested or not, and it is a great pity to arouse the interest prematurely.

I remember a small child giving as her news one day that there was a family of kittens at home. The class received it without much comment. Later in the day, however, the same child remarked to me: "I wish I knew where they came from. Granny says the postman left them, but I don't believe her." Knowing as I did, that the other children had shown no curiosity I sought an opportunity when she was alone—it happened most conveniently on the way home from school—and then I told her quite simply that the kittens had been growing inside the mother cat, and that she had "laid" them when they were big enough to live apart. Her only remark was "How funny!"

Of course, the advent of a baby brother or sister is the obvious time for instruction in reproduction, and then it is the Mother's duty and privilege to thus prepare her children. I do not propose to go further into this matter here. There are many excellent books written both for parents and for children of different ages. I would only stress here the inadvisability of continually dwelling on the subject to children too young to grasp the wonder of it or to have the sense to be somewhat discreet about the matter. So much has been taught lately (and *quite* rightly ) on the importance of sex-instruction, that some Mothers, in their effort to be natural and open, tend to treat the subject in an almost common-place manner, or so it appears to the teacher who hears garbled versions aired loudly at school by the so-called "modern child."

This, in its turn, has the effect of shocking some adults, who then and there resolve to keep their own little ones "innocent." Back swings the pendulum to the other extreme, and *these* children's questions are put off with "fairy tales" and

other white lies, which are not only wrong because they are untrue, but because they put Mother in a wrong attitude towards her children. They hear one thing from school and another from home—which is right? By degrees the truth asserts itself, and Mother is exposed.

CHAPTER II

# *Adventuring with the Sixes and Sevens*

WHEN I FIRST taught nature study, I laboriously made out a course of lessons for each term and conscientiously tried to keep to it, but soon became very dissatisfied. When I wanted specimens for a certain lesson they never could be found. This was annoying and wasted my time. Being of a naturally lazy disposition, I said to myself: "Why shouldn't the children hunt for these things themselves?"

As mentioned in the Introduction, my own experience told me that it was what children learnt when roaming the woods they remembered, not what the teacher arranged they should study in the classroom. Of my childhood days I recollect with gratitude the occasional help and encouragement given by sympathetic parents to ardent young naturalists in the guise of my brothers and myself. I remembered, too, a few well-worn Nature books generally bought second-hand or given to us at Christmas and birthdays, and the almost limitless scope (or so it seemed then) of an educational museum to which we had access. We were, in short, made to feel that our interests and activities had value, and we were never scolded for muddy boots and wet feet—or even when we lost the newts in the attic.

Thus there seemed to be good excuse for ceasing to plan courses and letting the children find out for themselves. But there was yet another reason for doing this. I was at the time teaching botany and biology to girls in a senior school. Their work was constantly hampered by their lack of general knowledge of the countryside. What had they been doing in their junior schools? They just were *not* on nodding terms

2. *The Children Feed the Birds*
Kindergarten bird table

with the common flowers in their seasons; they had never watched "sticky buds" unfold, or tadpoles develop, and they called *every bird with a red breast a robin*. I could only wish that these girls had had the chance to run wild in the country in their early years. "So here goes," I said, tearing up the pages of my nature study *syllabi*. "In future let the children and the seasons dictate."

Exploring the country with fifteen or twenty children is bound to create problems and difficulties not met with when two or three go out. It becomes necessary to plan some quest before setting out, in order to make the most of the available time and to set some goal before those not naturally so observant as to make the best of their opportunities when thrown on their own resources.

But although an object is desirable, the explorers should keep their eyes open to other interests, for it is the element of surprise that is particularly alluring to the field naturalist. A ramble to collect tree buds in Winter ends in setting up six fallow deer, thus making a red-letter day for the ramblers. During a flower hunt in the wood, someone discovers a willow-warbler's nest full of baby birds, hidden under the bluebells. It is just these lovely surprises that "make" the rambles.

A few unwritten rules will be evolved when exploring with a class. The party must keep together, or, if split into smaller groups, keep with their respective leaders. Children who run ahead not only miss much of what is seen and discussed, but also scare away birds and animals before the party has had a chance to see them. This is an unpardonable crime amongst field naturalists.

Flowers may be picked in moderation on condition that they are carried by their picker, and either put in water at school or taken home. Mud is not stepped in more than is absolutely necessary, so that animal footprints are not obliterated. When approaching a hole, this is a very necessary

precaution to take, for the mound of earth thrown up outside may not only tell us who, if anyone, lives beneath, but whether he is at home or lately gone out.

Stories of Red Indians and trappers stalking through the forests and reading the signs, help to give life to these rules and make them much more reasonable and attractive, especially if you add also that Red Indians *never* step on dead wood because the crackling sound would make the animals think it was a gun; or rustle the leaves as they move over them in their peculiarly even and unhurried strides.

Rules about talking and shouting are difficult to lay down, and are apt to spoil the spontaneity of the occasion. It is a matter rather of slow education by experience.

"There now," you point out to a disappointed group of youngsters, "you might all have watched the goldcrest go into its nest if certain people had not shot out their arms like guns and shouted 'Look!' "

But to demand quietness throughout the ramble would take off so much of the thrill of adventure that I prefer to risk missing a few birds rather than insist on absolute curbing of natural effervescence.

Explorers of this age will cover considerably more ground than the kindergarten group, and will enjoy testing their endurance in a long ramble. This may be done now and then, but it is unwise to make a habit of it unless there is unlimited time at your disposal, which, in my experience, there never is. It is a great pity to be hurried on a ramble, especially towards the end, when the most thrilling experience is sure to come.

"Oh dear," exclaims the harassed teacher looking at her watch, "and the bus leaves in ten minutes; we simply must hurry, children." And we tear ourselves reluctantly away from the robin with food in its beak. If only we had more time, we might have seen it go to its nest.

The quests decided upon for ramblers will be determined by the type of country and the scope it offers, the season and the

weather, and by the children's interests. Summer rambles are by far the easiest to arrange on account of weather and the wealth of material and the comparative dryness of the ground, enabling one to wander over rough pastures and heathlands which would be far too damp and muddy in Winter. Keeping to a path or road is always irksome to naturalists, especially when a number are working together, and yet in Winter it is often the only practicable course to take where children other than your own are concerned.

Foundations for ecological work later on may now be laid by making visits to different types of country as each presents particular seasonal interests, thus:—

*Spring*

Mixed deciduous wood for early flowers and trees coming into leaf.

Hedgerow for climbing plants.

Pond for water birds and frogs' spawn.

Beechwood for bursting buds and seedlings.

*Summer*

Mixed deciduous and beech woods, and hedgerow again for further developments.

The pond for birds nesting, e.g. moorhen and swan, and also swallows, martins and swifts seen hawking flies over the water.

Marsh and streamside for flowers.

Meadow and wasteland for flowers and insects.

Downland for flowers and butterflies

Heathland for flowers and for birds.

*Autumn*

The woods again for autumn colours, and fruits and seeds.

Wasteland, downland and hedgerow for fruits and seeds.

*Winter*

The woods again for tracking and for birds.

Stackyard for birds.

Pond for birds.

The appreciation of beauty and scenery should form a real part of the nature rambles, and visits should be made in season to the best primrose patch, bluebell wood, foxglove slopes, etc., and our good fortune may be shared with those who live in towns by sending boxes of flowers to a city school.

There is no necessity to point out the natural beauties. They will be absorbed without any promptings by the teacher if the atmosphere is a happy one

The question of working on observations made during the weekly ramble is somewhat difficult. Given a keen class, enough material for a month's study might easily be accumulated in a single afternoon. But I insist that the ramble be a weekly one, and consequently much that would be of educational interest cannot be adequately dealt with indoors. Try to have half an hour the following day for explanations, drawings, charts, etc. and if the children are capable of it, for making short entries in their nature diaries.

I am a firm believer in the nature diary habit, as it not only teaches one to record observations clearly and accurately, but later on it should encourage one to make regular observations on the same subject year by year.

The seasons at which our British birds sing could never have been accurately determined, as they have, had it not been for the careful, day by day recording of bird song by many ornithologists over a period of many years. The influence of weather on plant life can only be assessed in a similar way.

The first nature diaries should be simple of course; merely a spontaneous record in the child's own language, with a drawing on the opposite page.

I have amongst my treasures an untidy little nature note book, the nature diary kept by Maureen, aged six and a half. The illustrations are crude, but give a picture of Maureen enjoying the wild creatures she writes about. Here are a few extracts. Note that the date is given each time. This is an important habit to form.

May 13th.—

We found a Moth called the Emperor Moth. We put him in a cage. It laid 25 eggs.

June 2nd.—

I got three feet away from a hedge sparrow. They are very tame in our garden.

June 2nd.—

There are dozens of baby rabbits outside my bedroom window at Bracklesham Bay (where she was staying for the weekend). They come out to play when I go to bed.

July 8th.—

I went to Cowdray (Park) on Sunday. I saw herds of deer. I fed them. They are very tame.

September 24th.—

I went to Weymouth for part of my holiday. I was out on my walk when I saw what I thought to be a snipe. I saw it on the beach. (But the picture portrays something more like an Oyster catcher.)

Specimens collected during the nature ramble should be arranged on the nature table and labelled clearly and concisely. This takes time, and probably the end of the ramble is not the best moment. Flowers may be plunged into water, and other material left in a basket till next day when everything can be sorted and arranged and labelled, either before school starts or during a period set apart for it. Or the teacher may prefer to do it herself at her leisure after the children have gone home. This gives her an opportunity of thinking over the points she wishes to stress next day, and to classify and unify the work being done by the class.

This unifying is easier than it may appear, for we always have the seasons to help us. Keep a log-book of the nature activities of the class and you will soon find certain trends of thought appearing. In Spring it may be Spring flowers, or the activities of birds; in Summer it may be caterpillars, bees and wasps, birds' nests or flower families. In Autumn it will centre

round trees or fungi, and in Winter hungry birds and animals.

When any trend of thought becomes apparent in your log-book, put it before the children in some suitable form.

"As I was sorting the things we found on our ramble yesterday," you may remark, "I found we had two oak galls. They are here side by side on the nature table with the one Patricia brought the other day. And they are all labelled too. This is the oak marble, this the oak apple, and this the currant gall. You might see how many more oak galls you can find to add to our collection."

You then describe one or two others they may look for, and give a brief account of how galls are formed. This whets the children's appetites for further observation, and gives them a line along which to work.

And so the voyage of discovery goes on, not a mere drifting hither and thither among the many and diverse interests around us, but with a keen sense of purpose, and that constant wonder which makes the life of the naturalist so worth while.

Nature calendars, particularly in the Spring, are well worth keeping, and as these are kept by the whole class, they do not entail much writing for anyone. A convenient form of Spring calendar which suits this age is given on the opposite page.

It should be discussed and planned, and the first ten objects listed at the first opportunity in the year, but space should be left below for many more observations to be added. The seven-year-olds may well insert a column on their chart for "Place where found." In this encourage the children to write the habitat (e.g. hedge, common, wood, etc.) where their observation was made, rather than the name of the vicinity, as it is of more scientific value, and we want to encourage scientific method even at this early age, as well as a quick memory for objects in their environment.

The Summer term will yield such a wealth of material for a nature calendar that it may prove more practicable to keep a

| OBJECT | SEEN BY | DATE | PLACE |
|---|---|---|---|
| Primrose | Sally | Feb. 2nd | wood |
| Celandine | | | |
| Hazel catkins | John | Jan. 13th. | hedge |
| Chaffinches fighting for mate | | | |
| Blackbird singing | | | |
| Bird carrying nesting material | | | |
| Brimstone butterfly | | | |
| Frog's spawn | | | |
| Leaves on a tree | | | |
| | | | |
| | | | |

book in which the teacher writes down the observations as the children relate them, keeping the book always accessible to the class. Of course, many interesting things will be observed by the children apart from the nature ramble, and it is essential to continue the Nature News period mentioned in Chapter I.

News should become more clearly expressed and should be of a wider variety and of a more discerning character. There is so much the teacher may learn of the child's outlook by the news he brings to school and the way in which he expresses it. By his news the child reveals a growing æsthetic sense, a joy in being among wild things, and above all a sympathy for the small creatures in their difficulties and dangers. These many moods may be beautifully expressed by the naturally articulate child, or haltingly and bluntly by the inarticulate, but the discerning teacher will understand, though she may sometimes need to hide a smile.

It is Monday morning. The children are seated in a semi-circle; prayers are just over and the teacher enquires, "Any News?"

Peter comes out, fetches from the nature table one dog daisy in a pot of water. He faces the class and solemnly announces, "I saw a daisy to-day." Now the banks and meadows around the school are white with dog daisies, and the teacher makes some appreciative remark to this effect, and Peter returns to his seat.

Tuesday. Peter again faces the class.

Peter: "I saw a daisy to-day."

Teacher: "Yes, you told us about it yesterday."

Peter: "No, that was another daisy."

Jane attempts more narrative, but becomes somewhat entangled, so Vera helps her out.

Jane: "In the hedge we found a blackbird's nest. And one of the baby birds did fall out. And the mother bird did come and feed her babies."

Teacher: "Did she feed the one that fell out?"

On this point Jane was vague. She rambled on about when she saw it, and where she was going and who she was with, and then returned to her seat remarking complacently, "So we did bury it." Everyone, alarmed: "Oh, was it dead?"

Vera, soothingly: "Well, I expect it is now, anyway."

CHAPTER III

# *The Study of Environment with Juniors*

By the age of eight years, most children are able to read and write and spell with reasonable ease, and the acquisition of these skills opens the door wider to the various aspects of nature study that have been already peeped at. Not only can they now delve into books for further information, but they can do more in the way of recording their experiences: writing essays and compiling little books on big subjects.

The rambles taken by the children when younger have opened their eyes to many possibilities, and they are ready now for more systematic work.

Simple ecological studies may well be carried out if they are not pursued for too long a period at a time. Two terms is long enough for eight-year-olds, and contrasting plots should be studied at the same time, in order to get variety and to avoid any staleness creeping in. More about this appears in Chapter XI.

The compiling of a class or individual book about the locality offers incentive to the study of environment and includes local geography and history, thus bringing together these class subjects into one common study. No truer name for such a book written by the children could be found than "Domesday Book," and the idea may well be first put to the class by telling what the real Domesday Book is, and how it came to be written.

By blocking together the time allotted to history, geography and nature each week, and using it all for the study of environment, much longer periods become possible. In practice it is perhaps wisest to have one long period at the

beginning of the week when the class can go out to explore, and one or two shorter ones later for indoor work, such as discussion of points raised on the ramble, writing of reports, drawing maps, diagrams and pictures, and reading up the subject. Sometimes the excursion demands considerable preparation, in which case one or two short periods are desirable before the longer one devoted to outdoor work. However the details are planned, it is essential to have time for both indoor and outdoor work.

Some of the longer excursions will necessitate time being spent on them after school hours, and if these are planned for the Summer term, nothing will delight the children more than to take their tea and "make a do of it."

Throughout one Summer term, the children in forms I and II brought their tea one day each week and spent the afternoon exploring the country. They scaled the highest hills; they followed a stream from its source for a length of two miles; they rambled over heather-clad commons and through shady woods and chatted with wood-cutters and farmers; they found a wealth of animal and plant life, and they played Red Indians and Explorers, lighting fires and building huts and generally absorbing the good things of the country-side.

Incidently, their teachers learnt much more about their pupils in this free and happy atmosphere, for it brought out the best in the least promising, and gave scope for the very active in body as well as in mind. Likewise the children saw their teacher in a new light also. Let us hope it was a radiant one!

In planning such work as is entailed in compiling a modern domesday book of the district, the teacher should make sure of bringing in fundamental principles and real historical, geographical and natural history facts worth spending time on. Given overleaf is a table of work covered in the three subjects during a two-term "domesday book project," and I think it will be seen to have covered a field of information wider and broader than the collecting of mere local lore.

# SCOPE OF STUDIES RELATED TO THE COMPILING OF DOMESDAY BOOKS

## NATURE

Daily weather records kept co-operatively.

Nature Calendar kept co-operatively.

Plant and animal life of these habitats:—
- Oakwood.
- Heathland.
- Meadowland.
- Marsh and Stream-side.
- Hedge and Bank.

Detailed studies of:—
- Badger's earth.
- Birds' nesting cycle.
- Life histories of Brimstone and Peacock butterflies.

## GEOGRAPHY

### *Physical*

Relief of the land:—
- Sandstone hills.
- Clay valleys.
- Chalk Downs, North and South.

Streams and Rivers.

How the land is clothed:—
- Forest.
- Heath.
- Grassland.

### *Human G. and Maps*

One-inch Ordnance Survey Maps and their symbols.

Contours and Bench marks.

The use man makes of water.

The use man makes of the land:—
- Wood-cutting and charcoal-burning.
- Grazing (obsolete).
- Farming and Gardening.
- Iron foundries.

Land utilization map of Kingsley Green.

Characteristics of the four counties comprising S.E. England in which Kingsley Green is centred:—
- Sussex.
- Surrey.
- Kent.
- Hampshire.

(See Fig. 1.)

*Book used:—*
*World Wide Geographies*, Book III, *Exploring the British Isles*. J. H. Stembridge.

## HISTORY

*Norman Times* (Spring Term)

Life on a Manor such as might have existed at Kingsley Green.

How Domesday Book was written.

Norman Kings make forests (local woods, c.f. New Forest).

Norman houses and churches.

Shopping and travel (the lord of the Manor visits Winchester Fair).

*Elizabethan Times* (Summer Term)

Elizabethan explorers add zest to our own exploration, and the study of the world through their eyes helps us to see our corner relative to the whole.

Elizabethan houses and towns (Moses Hill Farm, Cowdray Castle and Midhurst).

Queen Elizabeth's journey from Farnham to Cowdray.

Elizabethan Culture.

*Books used:*
*History Junior Course*, Book III, *The Middle Ages*; Book IV, *A Century of Discovery*. C. B. Firth.

## OTHER SUBJECTS

*Handwork*

Model of Norman village in cardboard and paper, arranged, on completion, in a wild part of the garden to show proximity to wood, common and river.

*Poetry*

Poems about rivers:—
- *The Brook*. Tennyson.
- *Tide River*. Kingsley.
- *The Thames' Story*. Kipling.

Nature poems by Shakespeare and other Elizabethan poets:—
- *Ariel's Song*.
- *Winter*.
- *Wake Robin Redbreast*, etc.

Elizabethan music.

One needs to guard against the possibility of developing into an antiquarian society, or a "rare bug race." Points of merely local interest must not be over-emphasized; those which illustrate wider truths are the ones to dwell upon. The old maxim, "from the particular to the general" is a very important one to bear in mind. Learning to see one's own small corner as part of a larger sphere is a feature of international importance, and it is interesting to see it coming out more and more strongly as the course develops.

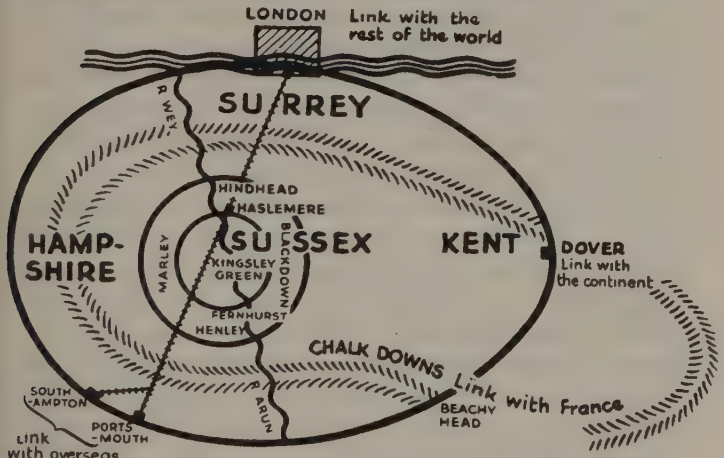


Fig. 1. *This is not an egg, but a diagram of no scale to show how a centre of interest widened from the school's immediate environment (Kingsley Green), to embrace the whole of South-East England and its links with the rest of the world.*

Let me give an instance from work done with children of eight and nine years. Kingsley Green, the hamlet which formed the centre of our studies happens to be the watershed of two insignificant streams, one flowing north and the other south. Neither is in any way impressive, but when it is realized that the muddy trickle in which the geese paddle on the Green eventually flows past Big Ben, beneath Tower

Bridge, and past "all those big steamers" at Tilbury; and that the other, flowing south, joins the River Arun, and has helped, through countless ages, to wear a way for itself through the South Downs at the Amberley Gap (which may be seen from the hill above the school) why, *then* geography begins to mean something!

One cannot divorce nature study from geography, because ultimately every living thing is dependent on earth, air, and water for its existence. For this reason alone it is legitimate to allow geography to creep into a book on nature study.

I am no historian, but anyone with an eye open to the curiosities of the country finds a thrill in the discovery of flint implements, Roman pottery and the like; and who does not take a quite unlawful pride in the knowledge that people of historic note have been connected with one's district! For junior children, both these aspects of history provide food for thought, but the life of people of past ages and how they fared in one's own district, and helped to mould its amenities, is the most prolific study. It fosters imagination and ingenuity; it makes the past live, and the present evolve from the past.

I see no reason why, in the study of everyday life of past periods, particular localities should not be peopled with imaginary tribes or villages of the age being studied, provided of course that the locality is, or has been a suitable one. History books are written for children about imaginary everyday people, and they give an excellent picture of the times: so why not people the places one knows and loves with them, too?

Tree dwellers and pit dwellers inhabit (during different terms) the woods around the school. Their huts are roughly built (by us) and they hunt and fish (in our imaginations) and go excursions to the top of Blackdown to visit the flint tool-maker. We go too, and find some of the many chips and unfinished implements left scattered about where he is really supposed to have carried on his craft.

The Romans come to our notice, and after learning some-

thing of their superior ways, an excursion is made (with the kindly co-operation of parents with their cars) to Stane Street, the British camp at The Trundle, and the Roman walls at Chichester. At each place we pause and play Romans and Britons, marching our legions along the Roman road, storming The Trundle with its three rings of defences, and patrolling the massive walls of the city.

During another term, Kingsley Green becomes a Norman village, and we the villagers. We take on the names of those days. A lord and lady of the manor are chosen, and a priest, and the rest of us are villeins and serfs. The Green itself becomes (in our imaginations) the common feeding ground of our geese and cows and goats, while our pigs wander into the woods to grub up pignuts and munch acorns and beechmast.

We are not very "good" in our Norman village, and some of us have enclosed narrow margins of land on the Green and called them "ours." Down the centuries they have become "ours" and are to be seen now as gardens and small fields begged off the common land.

And, yet another term, Elizabethan country folk come alive. We visit a farm-house of the period and see the massive oak beams that were blackened by smoke from fires in the middle of the floor before the chimney was put in. We visit also the ruins of Cowdray Castle, and with the help of pictures, reconstruct the stately rooms of this sixteenth-century mansion standing, as it still does, in a deer park of rolling grassland with avenues of majestic trees. We reconstruct the historic ride of Queen Elizabeth from Farnham Castle to Cowdray, when she trundled along in her heavy-wheeled, unsprung coach, the horses panting up Hindhead and requiring a change at the lonely inn at the top of the hill. Here Queen Elizabeth would rest also, and partake of a meal at the Huts Inn, ever since called the "Royal Huts," before trundling down Farnham Lane; and so by miry byways past Kingsley Green and Fernhurst to Midhurst. We look at these roads now, little

Although it will not, in most cases, be possible to follow any one stream from source to mouth, the study, begun out of doors, should be completed in the classroom, with the aid of maps, diagrams, and illustrations. With the older juniors, a fascinating course could be carried out around the study of water and its uses to man. To do this practically, access to a stream would be essential.

Such a course might comprise the building of a model town or village on a suitable site beside the stream (or river as it would be termed for the purposes for which it would be used), and making the latter serve the community in such ways as milling, supplying electricity, transport of goods, and pleasure boating.

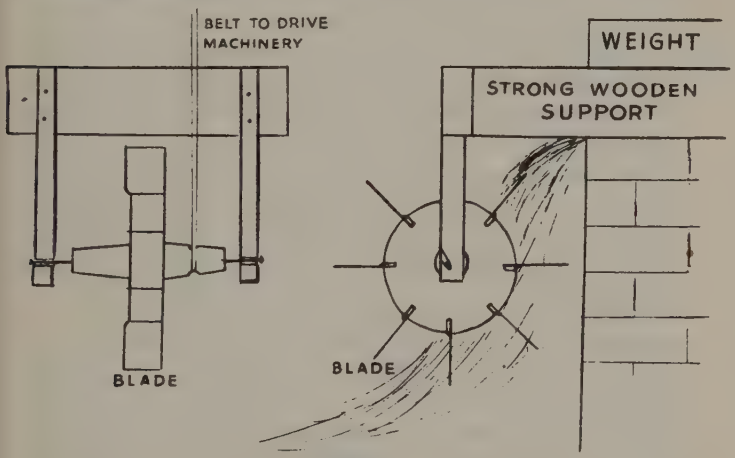


Fig. 2

*This Water-Wheel may be made with a solid wooden wheel. Make eight saw cuts at equal distances round the circumference and let into each a flat piece of tin cut to make a blade. This should be slightly wider than the rim of the wheel and bent over and hammered down to fix the blade firmly. A fall of water is required down a brick or stone wall on which the support is weighted to prevent it falling over.*

*(Design by Paul Baker)*

This would entail the study, first hand, of a water mill, an artificial waterfall, and a canal with locks; and then the construction, by means of wood, bricks, stones, earth, cement and any other medium that is practicable, of a model mill-wheel, dam and waterfall, canal with locks, barges and boats, bridges and fords, and a reservoir in such a position that it is not polluted by any of the other activities.

All this would take ingenuity as well as manual skill and hard physical labour, and though it is not expected that model houses would be really lit by electricity produced from the waterfall, the principle of the scheme would be understood, and much valuable knowledge would have been learnt in the way of planning the best position, relative to the whole, of each piece of engineering.

Everyone feels the exhilaration of a fine view, but it is astonishing the extent to which the appreciation is enhanced by a little knowledge of geography and geology. The study of views should form a part of the study of environment.

The following report written by a child of eight is quoted rather for the suggestions it proffers than the descriptive detail it includes. At the age of eight one records the bare facts in the realization that one's teacher understands their significance!

"THE VIEW FROM BLACKDOWN"

"Yesterday we went for a picnic up on Blackdown. From the top we could see Lurgashall Mill Pond, the South Downs and the chalk cliffs. The River Arun flows through (the) Amberley Gap. The weald has got lots of fields and woods on it. Mary's home is amongst the trees. It is called 'The Telegraph.'"

By an older child the composition would probably have included a short description of Blackdown itself (its height

and geological formation at the least) and would have made it clear that the chalk cliffs seen were not by the sea, but were chalk quarries cut in the Downs beside the Amberley Gap. Moreover Mary's home (among the trees) is a feature of historic interest, being an old telegraph station used to convey the news of the Battle of Trafalgar from Portsmouth to London by semaphore. From our vantage point just above "Mary's home" we could see other hilltops which also had telegraph stations in the same chain of communication. All this, and more, the eight-year-old children appreciate though their pencils do not work fast enough to get it all down on paper.

The study of a view should include as many of the following points as are relevant:—

1. The hill from which the view is seen. Its height above sea-level, aspect, vegetation, and main geological features.
2. The View.
   General direction.
   Distance of furthest object seen on a clear day.
   Direction and distances of chief features.
3. Hills appearing in the view.
   Their heights.
   Their shapes and geological formation and vegetation (e.g. rounded chalk downs, steep escarpment, wooded or grassy).
4. Valleys and Plains.
   Vegetation—
   (*a*) Natural.
   (*b*) Cultivated.
5. Water Courses.
   Their direction and relation to hills, valleys, and plains.
6. Towns and Villages.
   Their relative situations.
7. Roads and Railways.
8. Historical features, e.g.—
   British camps.
   Stone circles.

Church towers and spires.
Castles and monuments.
Historic means of communication, and transport:—
Beacons and semaphore stations.
Roman roads.
Pilgrim's Way.

This will involve the use of map and compass, and though much of the study will be carried out at the view-point, many of the details may well be filled in in the classroom, where the working conditions are easier.

Geological studies should be of the simplest, and nothing beyond the grasp of the children should be attempted, though opportunities for fossil hunting will naturally open the door to yet another fascinating aspect of nature.

The following extract from a domesday book by a boy of eight gives an idea of the simple treatment of local geology.

"THE GEOLOGY OF MARLEY LANE"

(Marley Lane is an old road running up a hill at a gradient of about 1 in 7.)

"At the bottom there is clay. And a bit further up you get sand from the bed of the stream. The stream comes out where the sand and clay meet. Then you come to sand and big slabs of sandstone. We found an iron-stone. Then when you come to the top you get a very fine light grey sand."

Now the writing of domesday books is not going to occupy the whole of the last three years in the junior school, i.e. from the age of eight to eleven. It is probably only going to take one, though other ecological studies will occupy at least part of the other years.

Running concurrently with the broader work of exploring the locality will go many detailed studies carried on as opportunity occurs. These are largely dealt with in Part II, but I

would like to end Part I by stating the goal towards which one should aim in teaching nature study throughout the junior school. Listed as it is below, it may appear like an examination syllabus, but it comes to life at once when studied out of doors amongst wild life.

On leaving the junior school at eleven years, the child should be equipped with a wide elementary knowledge of natural history gained through a study of plant and animal life in the field and classroom, particularly the following:—

The habits of mammals common to the locality, and their adaptations to mode of life.

A knowledge of bird life (nesting, song, migration, etc.) gathered through the study of the life histories of birds of different types.

Life history of frog, toad, and newt.

Life histories and feeding habits of:—

Butterflies and moths.

Bees and wasps.

Dragonflies and other pond insects.

Spiders.

The division of the insect's body into head, thorax and abdomen.

The appendages (legs, wings, antennæ), their number and place of attachment.

The position of the breathing apparatus (spiracles) and silk-producers (spinnerets).

The exo-skeleton and need for changing the skin during growth.

The form of the body during larval and pupal stages compared with that of the imago.

The recognition of a number of flowers, and an elementary knowledge of classification.

The parts of the flower and their functions.

Seed dispersal.

Behaviour of cotyledons in growth of seedling.

Food stores and vegetative reproduction.

Chief characteristics of hydrophytes, mesophytes, and xerophytes.

The recognition of the trees common to the locality in Summer and Winter, and their buds, flowers, and fruits.

The common groups of non-flowering plants:—

Ferns, fungi, mosses, liverworts, and lichens.

The recognition of the spore-bearing organs in each where apparent without the aid of a lens.

Popular names of some ferns and mosses.

The chief groups in the classification of fungi, taken elementarily:

Gillcaps, sponge-caps, spine-caps.

Jellies.

Clavarias.

Puffballs.

Pezizas.

The parts of the fungus plant as seen with the naked eye, and their functions.

# PART TWO

CHAPTER IV

# *The Quest for Mammals*

## THE TRAIL

THERE IS PERHAPS nothing more exciting for children to do on a nature ramble than tracking. It appeals to the hunting instinct, and where the adult is more than satisfied if the trail leads him to the animal's home, children are ever optimistic of its leading to the animal itself. They are quite unconscious of the fact that they are themselves making enough noise to scare every animal for miles around to the very innermost recesses of their holes.

Tracking is best done in Winter, either in mud or snow. In snow it is easier provided the animals have been out the previous night, and provided also that there has not been a recent fall of snow to obliterate the footprints. It is after a slight fall of snow that one searches the bounds of the garden to discover where the rabbit gets in.

The difficulty in tracking with a class of children is that they cannot all be leader, and tend to get in each other's way and to tread on the tracks. If it is at all possible to divide the class and take not more than six at a time it is a great deal more satisfactory from every point of view. Children are very quick to grasp the idea of tracking and are most observant and imaginative. They remember the patterns of spoors easily and can visualize without difficulty the direction in which the animal was travelling. So before you take the children tracking, have a talk on the footprints you are likely to see, and draw them on the blackboard.

Rabbits will have been doing bunny jumps everywhere. Get a child to demonstrate a bunny jump and you will then

get the idea of the direction of the rabbit's trail. The rabbit puts his front feet down near together, bringing the back legs forward, one on each side, so that they leave an imprint wide apart and a little in front of the fore paws. In very hard snow the claw and pad marks may show, but this is uncommon.

Deer marks are like sheep or pigs'—a small, cloven hoof very neat and pointed in front. When the deer jumps, the weight of its body may not only drive the front hoofs deep in the snow or earth, but splay out the toes.

It is well to be familiar with cat and dog tracks in order to avoid confusing them with fox and badger. The cat's neat, round little pattern never shows claw marks. Pussy keeps her claws in sheaths, protecting them and keeping them sharp for their deadly work. The dog, on the other hand, shows claw marks as he walks, and so do badger and fox.

It is worth while drawing a human handprint to compare with those of dog, fox, badger, and cat. In each there is the hand pad, and radiating from it, four or five finger or toe pads. We, of course, keep our claws cut, so they do not show in a print! Fox's footprint is so like that of a small dog that it is not always possible to distinguish them. Where a trail can be seen, however, it is seen that the fox places all four feet in a single line, and frequently the hind foot steps partly in the slot of the fore foot. Moreover, he frequently trails his bushy tail in the snow, leaving a brush mark between the footprints. Where you come across the musty scent of the fox, you have an unmistakable clue to the footprints. Dogs place their feet in a double line and so do badgers, but cats favour foxes in the single line.

I have found many badger tracks in the woods, and the point that always impresses me about them is the shape of the hand pad. It is roughly triangular in dog, fox and cat, but a long oval, almost banana shape, in the badger. Coming off this, almost in a straight line, are five toes, and if the print is clear, five long claws, too. A badger leaves a double trail as a

dog does but frequently the hind foot partially covers the slot left by the fore. An old badger, particularly, turns his hind feet in, though walking straight forward with the fore ones, and as the hind feet are larger than the fore, you get a curious footprint left, as shown in Fig. 3. Rat, squirrel, and water vole all make footprints like little hands.


Fig. 3. *Paddy Paws*

Tracking in mud is not so simple as in snow, but sometimes extraordinarily clear prints may be found. Then it is worth while taking a plaster cast to add to the nature table or museum collections at school. Children from eight years onwards can make plaster casts quite well with a little help and advice. Fresh plaster of paris from the chemist is taken out in an air-tight tin. A bottle of water and an extra tin, such as a cocoa tin, is also taken, for mixing. When a suitable spoor has been found, build a tiny mud wall around it to prevent the paste running away. This wall must be built with the utmost care to prevent any disturbance of the spoor or any earth being dropped into it. If desired, strips of cardboard may be placed round, instead of the mud wall. The plaster is then mixed with water in the mixing tin, being well stirred with a spoon or a stick until the consistency of thick cream, when it is poured into the spoor and left to dry. It should be hard in about ten minutes and may be lifted from the ground, wrapped in paper and taken back to school. There it should be put in a warm place until the earth adhering to it is dry, when it may be cleaned with an old brush.

A collection of such casts is of considerable interest and may be used in demonstrating footprints, by pressing them in a tray of sand to make the imprints of the animals again.

It is probably through tracking that children's interest in wild animals is aroused. But tracking is not only done by following footprints. The animals leave all kinds of other clues to show where they have been—gnawed bark, droppings, a little tuft of fur, broken nutshells, all tell their story, and once children are made aware of the possibilities, they will rapidly exploit them. Quite little children will enjoy searching for "squirrels' crumbs"—nuts opened in half, acorn and chestnut skins left empty, and pine and fir cones with scales torn off.

Less pleasant, but none the less telling, is the fox's cache. Rabbit fur and bones, and probably hens' or ducks'

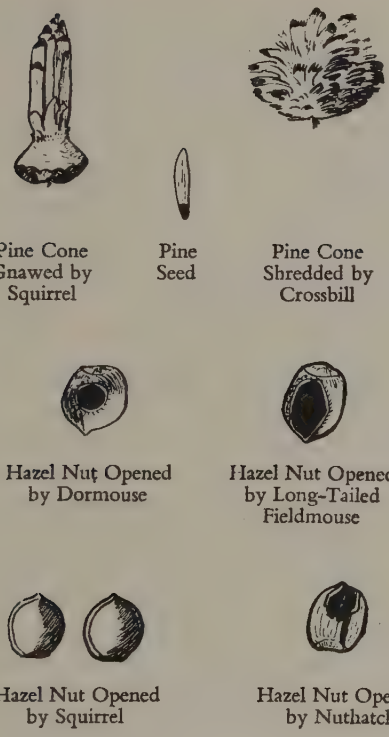


Fig. 4. "*Crumbs*" *Found in the Wood*

feathers strew the ground under some thick bush. The feathers have been bitten off at the quill as cleanly as if they had been cut with a penknife. A vixen will take great care to leave no tell-tale scraps around the entrance of her hole, though the dog fox is less particular. She is even wary of leaving footprints on the sand outside the entrance, though one can generally find one or two to tell which way she went.

## BADGERS

A visit to a badger's earth has much more to show, and a most happy and profitable half hour may be spent searching about the holes and deducing what theories one can from the evidence to hand.

A well-established badger's earth probably comprises a number of holes. These may be on a wooded hillside not far from water. Some of the holes will go down beneath trees, their roots strengthening and supporting the tunnels. Large mounds of earth are flung up, and traversing these are well-worn tracks leading from the holes out to the surrounding country. Piles of earthy bracken and leaves may be found near the entrance holes, these being stale bedding brought out by Brock. He is a cleanly animal and changes his bedding several times a year. I have found heaps of oak twigs complete with leaves also. These must have been used for bedding in their green state, for the leaves, though dry and dead, were still greenish in colour, as they would be if dried in a dark place. Amongst this tangle were many badger hairs. After a thorough examination of the holes has been made, the various well-worn footpaths should be followed. One will lead down to the water, another to the edge of the wood, where a bold way has been made through the hedge into the field beyond. Another path will lead to an oak tree which has served for long as a rubbing post. The bark is rubbed, and there is sand and some hairs in the crevices. The ground around is bare and hard as if badgers had run round and round the tree many times. Higher up are scratches in the bark showing how tall badger is when he stands on his hind legs to sharpen his claws. The path leads on from the rubbing tree to a little square pit in the earth containing the fæces of the badger. What an intriguing creature the badger is! His personal habits are above reproach, but how he makes his little latrine square, is beyond my comprehension.

Here and there are scrapings in the earth, uprooting the bluebell bulbs, for Brock is fond of their sweet succulence; and if you are very fortunate you may see where he has excavated a wasps' nest, digging it out of the ground and leaving only bits of the papery cover.

All this evidence of badger's whereabouts makes one long to meet him in person. The lateness of the hour and the long vigil necessary makes this treat more suitable to the adult than the child. It entails a preliminary visit to an earth by day to make sure badger is living there, and to decide upon the best spot in which to stand or sit for the vigil, for it is most essential when you do go there at night, to creep in and settle down as silently as possible. June is probably the best month for your escapade, for then the night is shortest and warmest and badger is sure to come out fairly soon after dark. The midges will be out before him, of course, but your only precaution against them must be to cover as much as possible of your body. It is wise also to darken your face with cocoa, as in the moonlight it will look very white and ghostlike and may send Brock scampering into the bowels of the earth if he sees it.

Choosing then a warm, light night, a day or so after you have made your preliminary investigations, you creep into your place shortly before sundown, and prepare to wait upwards of an hour. But you need not be dull. The day birds are singing their dusk chorus, dropping out one by one till the gathering gloom is broken only by a sleepy robin or a far-away thrush. Then the night birds begin. A nightingale srtikes up from the hazel thicket by the stream, a little owl mews plaintively. From just over your head a brown owl suddenly hoots, making you jump with the loudness and nearness of it, and it flaps off on silent wings in search of food for its family. A startled pheasant crows, and just over the rough tangled field away on your left, you hear the gentle purring of a nightjar. A sharp ugly yapping tells of a

fox astir, and a challenging bark from the farm across the valley, that the sheepdog also has heard him.

"I mustn't forget what I'm really here for," you think, looking down at the dark hole below the bank where you are sitting. There is no sign of movement.

"Bother the midges! I thought there was no chink between my gloves and coat, but they've found my wrists already. Oh, and there's one at the back of my neck. Wish I'd brought a bigger scarf. . . . That stone must have crept in after I sat down . . . I'm sure it wasn't there before. Do I dare move off it, or will something happen?"

You look hopefully at your companion. She is lost in thought. "Must be composing a poem at least. Wish my seat were as comfortable as hers. I shall bring a cushion next time."

Then you are aware of something. There at the entrance is a shadowy creature moving about. He smells the earth, turns and smells the air in your direction, and you see the clearly striped grey and white head of badger.

Devoutly hoping you won't be the first to move, you gaze back at this silent creature of the night. You never really thought you would see him; hardly believed all those signs meant a live badger—and there he is! But he has suddenly become suspicious and gallumphs noisily down his hole again.

You exchange glances with your companion and wait a bit longer. There are scuffles and snuffles further along the bank now, and you strain your eyes in an effort to make out whether it is another badger or merely moonlight and shadow you can see near another hole. But soon your badger appears again, and this time he decides that discretion is the better part of valour and makes off at a quick amble downhill without another look in your direction.

The entertainment over, you creep on cramped legs away from the wood, and once on the road you give tongue. "When did you first see him?" "Did you see. . . ." "Did you hear . . .?" etc. etc. all the way home.

4. *The Study of Water and its Uses*
Home-made water wheel at work

On one occasion when watching for badgers, my companion and I had not been settled more than ten minutes, and it was still light, when one appeared. It was quite unaware of our presence, and we watched it amble up its well-worn path and disappear over the brow of the hill. It was about the size of a very large cat, or a cairn dog, of a squat, spreading figure, with a long, coarse coat, grey on top, darker beneath, and blackish legs. Its head, with its characteristic grey and white stripes, was long and pointed.

I give this story of badger watching, not because children will be able to do it, but because it adds tremendous zest to the nature work of a school if the teacher can herself see some of these less usual sights. The children will catch her enthusiasm so readily, and she will tell her nature stories with such colour if they have really happened to her.

Never was the nature work at a higher standard in my school than when I myself was engaged on bird research work, on my own account. There were so many little tit-bits I could tell the children about wild life in the early hours of the morning (for my work entailed being abroad before dawn) that they readily caught my enthusiasm, and the picture of the creatures of the wild carrying on the business of living, each in his own peculiar way, became extremely vivid.

## YOUNG ANIMALS AND EVOLUTION

There is not a great deal that may be done with children in the way of studying the "nesting habits" of mammals except as, on rare occasions, a mouse's, or squirrel's, or perhaps a mole's nest is discovered containing the young. Then a fleeting glance, and cover them up quick! is the rule. The inevitable question, "How did they get there?" is sure to be asked, and must be answered truthfully. In all probability the appearance of naked blind baby animals will not be altogether unfamiliar to the children, especially if they have cats and dogs of their

own, but the fact of their being in a nest may prompt them to ask if they came out of eggs.

"Do hedgehogs lay eggs, or do they have kittens like rabbits?" a small boy is reputed to have enquired.

I do not think junior school children are too young to understand the essential difference here between mammals and birds: that while young birds are laid in the egg and continue to develop in the shell outside the mother's body, yet in mammals the egg develops into a young animal within a special bag inside the mother's body called the womb or uterus, and does not make its appearance as an independent creature until it has grown head and body, arms and legs, and other parts similar to its parents. And that after it is born it is fed (suckled) for a period on milk from its mother, who has special glands for this very purpose. This necessitates much care and devotion on the part of the mother animal, who alone can bring up her young until it is old enough to eat the kind of food she does.

In this way one is inculcating the idea of evolution; of the higher form of life requiring more care and devotion from its parent, leading up to human love and devotion. Instance, in contrast to mammalian parenthood and childhood, frogs and toads, and insects, who take no further notice of their eggs once they are laid and fertilized.

Never miss an opportunity of opening the doors of evolution and biology even if, in the junior school, at any rate, it is only lightly touched upon. An intelligent child will discover so much for himself, once the ball is set rolling, and nowadays there are so many excellent books to help him, if he has the impetus and the practical knowledge gained in the countryside.

## ANATOMY

Some elementary anatomy may well be done with skulls and other bones picked up on rambles. Children can have

little notion what is inside their own skins, but the actual handling of bones, so that they become acquainted with their shape and articulation one against another, is paving a most pleasant track for later biological work. I remember as a child trying to reconstruct the skeleton of a rabbit from the odd bones picked up on my frequent country rambles. Although I never succeeded completely, I got the main bones, and incidentally achieved a longing to understand teeth. From the many rabbits' skulls in my possession, all imperfect as regards teeth, I would take one from this jaw and put it in a corresponding gap in that, trying to furnish at least one unfortunate dead bunny with a complete denture.

My dentist lent me a book on teeth (after, I believe, I had shown him my odd collection at an appointment), and how proudly did I pore over it, determined to fathom the dentition equations!

I never had the least inclination to become a dentist, but I have retained my interest in teeth and their uses, and can still examine with some small spark of intelligence and much interest, the skull of an animal found by the wayside.

### COLLECTIONS TO MAKE

Animals' crumbs.
Skulls and skeletons.
Plaster casts of footprints.

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CHAPTER V

# *The Quest for Birds*

A MORE ENTHRALLING hobby than bird watching I cannot conceive, but then I am prejudiced. Ever since I can remember, birds have been my chief fascination, and the Easter holidays the best by reason of the nests to be found and the Summer migrants to record.

It is, however, one of the most difficult subjects to "take with a class." It must almost of necessity be done individually. No self-respecting bird is going to stay on the branch while a rabble of twenty kids rush at it pointing and exclaiming loudly. And yet I must give the kindergarten their due. They tiptoe from tree to tree and find a robin sitting in each. And, such is the novelty of youth, they are quite content that they should all be robins.

Bird watching is a subject in which enthusiasm is easily roused to the pitch of inciting many children to carry on their observations alone. This is one of the main objects of nature teaching.

Therefore it would seem that the work of the nature class at school is to set the ball rolling, and to encourage the children to follow a fascinating pursuit individually.

Some suggestions as to how this may be done are made in Chapter I; here are some more, generally speaking, suitable to the older child.

## RAMBLES

Organized bird rambles are best made to some spot where one may be fairly certain of seeing one or two birds really clearly. Hedgerows and woods are poor in this respect as they

harbour for the most part small birds, and offer easy concealment for them. So do not start with these, or the children may become discouraged at seeing little.

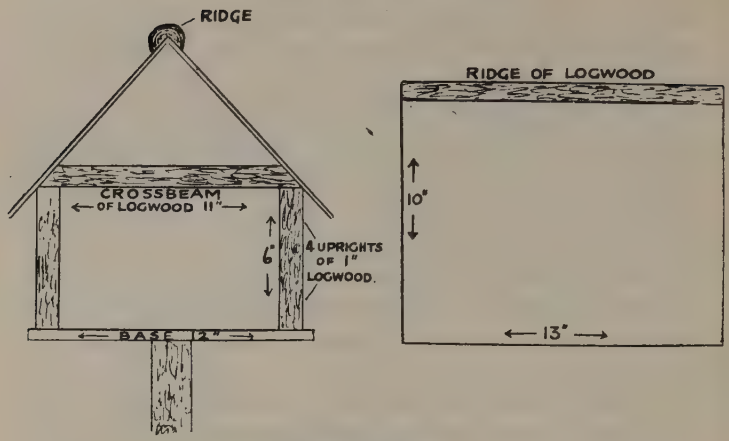
A pond with ducks, moorhens, and swans makes an excellent beginning. The children can stand on the bank and get a clear view, and very probably some of the birds will be tame enough to come and be fed. A field where peewits abound, a river bank or the sea-shore are all excellent spots if you are lucky enough to be within reach of them; or a church or ruin where jackdaws nest, a rookery or heronry also make good excursions, and you would almost certainly see other birds besides those you set out to watch.

It will be noticed that the places mentioned above furnish large birds. This as an obvious advantage, but it must be remembered that little children adore little things, and little birds such as robins and wrens, tits and warblers, are the ones that will entrance the children most, by the very reason of their diminutive size and elusiveness.

## IN THE GARDEN

Feeding the birds gives perhaps the best opportunity of watching these little ones, and each classroom should have its own bird table, if possible in sight of the window, and a little above its level. Bird tables are easy to make, and may be made in the woodwork class by anyone over seven. Plans of two kinds are given in Fig. 5. The measurements may be adapted to suit the wood at your disposal.

In the country at least ten species of birds may be attracted to the bird table if a variety of food is put out. Lumps of fat attract nuthatches as well as four species of tit (blue, great, marsh, and cole). Bones for the tits to swing on, and strings of monkey nuts may festoon the table, while on it crumbs, bird-seed, and berries will make the mouths water of various finches, robins, and hedge-sparrows. A nut container is not difficult to




*Roofed Bird Table*

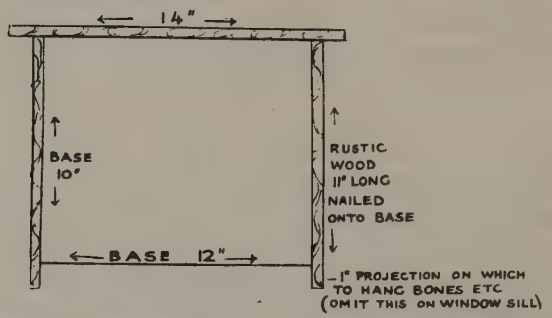



Fig. 5. *Plan of Simple Bird Table for use on a Pole or Window-Sill*

make if you do not mind using your scissors to cut perforated zinc! (See Fig. 6.) It enables the nuthatch, who has no head for acrobatics on a string of nuts, to have something firm to which to cling as it pecks out pieces of nut through the holes in the zinc. It demonstrates excellently the method by which the nuthatch hammers out the kernel of a hazel nut wedged in the crevice in an oak tree. On the bird table should be a bowl of

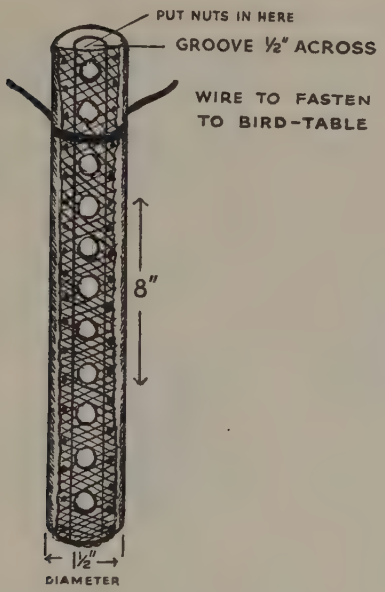



Fig. 6. *Nut Container*

Made from a log of wood and perforated zinc.
Hollow out the wood with a red-hot poker, or penknife.

water kept full and clean, or better still, near the table, a bird bath.

This may be made out of an old washing bowl, preferably one with a wide rim on which the birds can perch. A leaky one will do. Cement it smoothly on the inside and roughly on the outside, to render it somewhat "rustic." Then build a pillar thus:— Take three one-pound cocoa tins or their equivalent. Fill each with sand and stones to make them heavy, and standing one on top of the other, cement them roughly but firmly together. Cement them to a flat stone base and stick the bowl on the top, also with cement. Wouldn't your ten-year-old boys like to make this? If you can contrive

to collect water from a roof and run it into a shallow cemented pond in an open situation, this will also please the birds mightily, but the working out of this piece of engineering must be left to your ingenuity.

Nesting boxes should be placed in suitable places to attract the tits and nuthatches to build where the children can watch them. There has been much discussion as to what constitutes the correct site for a nesting box, but my experience is that birds only require that the mid-day sun shall not shine full on their nursery, and that there shall be cover in the form of a bush or tree nearby to serve as a jumping-off place for parent birds in their frequent visits to the nest.

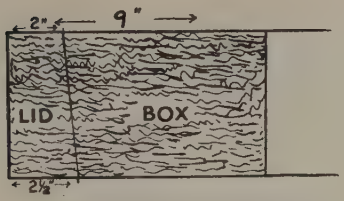
Nesting boxes may be simple or hard to make, according to taste. If you require a rustic box made from a log, then ask your big boys to make it. But if you are not so particular as to looks (and I assure you that birds don't mind), the eight-year-olds can make quite successful boxes out of boxwood. The plans of two types are given in Fig. 7. A class of little girls made nesting boxes one year, and the tits occupied them within a few weeks of their being erected. One small girl, not naturally adept with her fingers, nailed her box together so carelessly as to leave long draughty cracks.

"The tits will laugh at your nesting box," we told her, holding it up to the light. So you may imagine Diana's glee when hers was the first box to be occupied! (See Fig. 7B.)

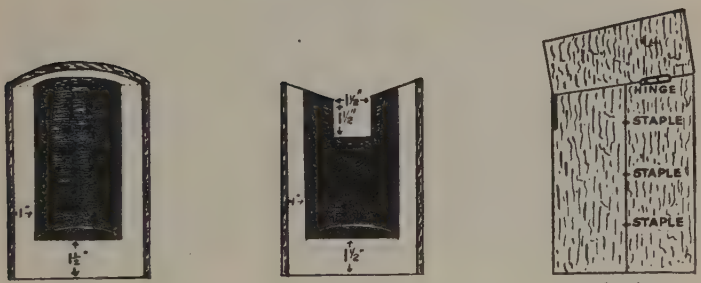
But your brawny-handed boys, with more strength than they can legitimately use, may burn up some kinetic energy in making really professional-looking boxes from logs of wood.

Choose your logs carefully for their straightness and the condition of their bark. Perhaps pine and birch are the most attractive, but oak and ash will wear longest (and require most strength to make).

Of the two ways of making the boxes, that of hollowing out the log without first splitting it is obviously the best and most difficult, but the other way, illustrated in Fig. 7A, makes

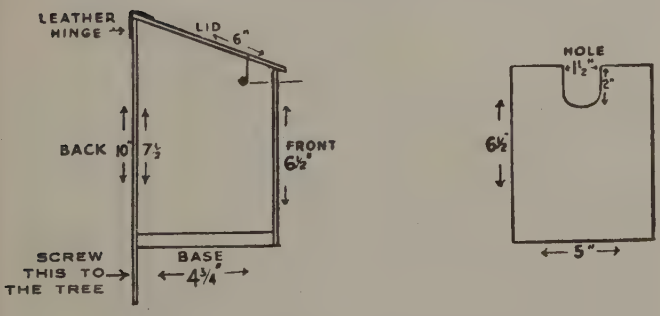



*Log Cut for Box and Lid*




Back (inside) | Front (inside) | Side view (outside)

A. *Nesting Box Made from a Log*




Side View | Front

B. *Nesting Box from Boxwood*

Fig. 7.

quite a serviceable box and commends itself to the less skilled workman. To hollow out the logs, either split or unsplit, first fix the wood securely in a vice, and make a number of holes with a bit and brace. Then chisel out the wood with a gouge and mallet. This takes some time to do, but remember that the birds will not be critical if you leave it slightly rough; in fact they probably prefer it so.

In all cases make the boxes with lids that open, so that the children may watch all stages of nesting and may find tits roosting in the boxes in the Winter. A mirror is a great help here. Procure a motor-bicycle mirror and screw it on to a stick about five feet long. Then you can open the lid of the nesting box and arrange the mirror above it in such a way as to reflect its contents. Children standing in a group below look into the mirror. The mirror may also be used for reflecting light into a hole or other dark corner in which there is a nest.

## A BIRD SANCTUARY

If the school is blessed with a garden, as, indeed, all schools should be, it is not difficult to make it a bird sanctuary. Cats must be discouraged, and all feeding and nesting facilities arranged so that no cat can possibly reach them, for where birds are regularly fed they become semi-tame and fall easy prey to cats. And where such birds abound, there cats will come if they can. The garden should not be kept too tidy. Some thick growing bushes with small leaves and dainty twigs are attractive as nesting sites for blackbirds, thrushes, finches and hedge-sparrows who are not attracted to the coarse growing laurels and rhododendrons. Suitable in this capacity are lonicera (*L. nitida*) hawthorn, blackthorn, privet, dogwood, spindle, berberis (several species), and bamboo. Almost any tree, shrub or climbing plant grown against a wall will offer attractive nesting sites for flycatchers, and if not too well pruned, chaffinches and wrens will also find nooks and

crannies. Ivy-covered trees and tangles of honeysuckle also provide suitable sites, and I have known an ivy-covered oak tree within a few feet of our house to contain three flats; a wren's nest about five feet up, above that a greenfinch's, and a little higher still, a blackbird's. They were all occupied at the same time.

Dry stone walling and rockery, with here and there a hole partly concealed by overhanging rock plants, attract tits, particularly the mousy little cole-tit, who much prefers an earthy hole to a nesting box.

Then there are certain berried bushes one should grow for Winter feeding: rowan, barberry, elder, ivy, firethorn, and cotoneaster are particular favourites. Rowan and elder trees are generally stripped before the middle of September around my garden, and the barberry with blue-black berries, though standing guard beside the front door, has all its berries stolen long before the Summer is over. It is the privilege of the kindergarten form that its window looks on to the rockery in which is a fine specimen of cotoneaster horizontalis. In the Summer the little waxy pink flowers are a-buzz with busy bees, and in the late Autumn and Winter the birds come to the feast.

They are quite regardless of the eager faces watching them from within the room.

Don't cut down the rose hips in the garden too soon. Who knows, they may one day attract a waxwing, and until then many of the commoner birds will be grateful for them in cold weather. Do not be in too much haste, either, to clear away the dead flowering stalks of the late summer flowers. Michaelmas daisy, aster and cosmos attract little parties of goldfinches, who will return day after day to the same unsightly brown stalks, rendering them at once beautiful with their gay colours and spritely movements.

It is the daily round, the domestic life of birds (and animals too) that interest children most. They want to see how a bird eats and drinks, sleeps and wakes; and above all how it

manages its nursery. A little girl of seven made me promise solemnly at the beginning of the Summer term, that I would show her a nest with eggs in, "as I haven't seen one yet."

A maid we once had told me she had found a nest with five blue eggs in it. She and her young man had come on it when "out walking."

"Was it a hedge-sparrow's," I suggested, "or a thrush's?"

"I don't know," she replied, "I didn't know what to do with it, so I took it home and put it in the cupboard under the stairs."

Wanton ignorance such as this, leading as it frequently does to downright cruelty, could be almost wiped out if a healthy interest in birds was aroused in the lower forms of the schools. It is through the devotion of the parent birds in their building of the nests, in the delicate eggs, the frail and helpless babies that one's sympathy is most drawn out. It appeals to the motherliness of the little girls and the chivalry of the boys. Above all, children must see, and see again and again, the nesting cycle of familiar birds.

In our woodland school, there are many delightful opportunities for this, and the children carry away with them many lovely memories.

There were the marsh tits in the nesting box outside the kindergarten window; and the garden warblers in the bushes by the playroom. The class working there for the Summer did arithmetic to the tunes of Mr. Garden Warbler's bubbling song.

Then there were the willow warblers, who, I am sure, would have selected a site deeper in the wood had they known that Form I would settle itself daily to its lessons within five yards of their nest. But the willow wrens had started to build in the holidays and it seemed a pity to give it all up, especially as no harm came.

As a matter of fact, the children were not shown the nest until a few days before the birds left it, as I was afraid the

temptation to visit it too frequently would have led to disaster. So, as it was, the whole class had the joy of seeing those seven baby warblers—balls of apple-green fluff, *so* soft, make their appearance into the wide world beyond their nest. They perched about the bushes behind our desks and were fed by their parents. They appeared to have no fear at all. I suppose they had been familiar from birth—a fortnight ago—with our chatter and movement.

But perhaps our favourite bird is the wren which nests annually in a slit between two beams in the porch. Sixty children and teachers pass in and out many times a day, but the wrens know they are safe. No one could get a hand in even if they wanted to, the slit is too narrow, and quite out of reach without a ladder. So as the ten or so babies grow old enough to begin to take notice, ten or so yellow gapes appear in a row along the slit, and ten or so pairs of black beady eyes look down on us, mere humans, buzzing about below. And, of course, we look up at them.

We have our disappointments, too; many since the grey squirrels became so common. A pair of bullfinches nested in the lonicera hedge near the back door, and I was a little alarmed when my niece confessed that she had "helped" a baby bird out of its shell. I assured her it needed no help and was best left to struggle forth alone. However, no harm had been done and we continued to watch the family grow for about a week when suddenly they all disappeared. A pair of grey squirrels had their drey in an oak tree nearby, and the evidence against them seemed strong, taking into consideration their bad history. Not that red squirrels are entirely above suspicion either, for I once saw a red squirrel with a fledgeling robin in its mouth. But now we see no red squirrels where once they were the cherished inhabitants of our woods, and even fed from our bird table.

## THE NESTING CYCLE

The general outline of the development of the bird is well known, and many books deal effectively with it, but many interesting details are omitted from most elementary books; details that crop up as everyday problems to the would-be bird watcher.

I remember when I was a girl I set myself the task of discovering the length of time incubation took, and also how long the chick remained in the nest. I believed that this had never yet been ascertained as it was not to be found in the books at my disposal. So I was a research student!

Linnets were chosen for the investigation for I knew a common on which several pairs nested. This was two miles away, and school restrictions enabled me to visit the spot only twice a week. Consequently my research was far from accurate. But if I failed to add anything fresh to ornithology (and I found afterwards that the incubation and nesting periods had already been adequately worked out) I certainly learnt much myself.

It is a help in answering children's questions to be able to tell them that most small birds lay one egg daily, and commence sitting when most or all the clutch is laid. As a consequence of this, the young hatch on approximately the same day. Owls and hawks, moorhens and some others start incubating when the first egg is laid. Moreover, they do not lay more than one every other day. so that the young are all of different ages.

Incubation is long or short according to whether the chick when hatched is clothed with down and is able to run about and pick up food, or is blind and helpless and lies in the nest for a period. Chicks which belong to the former group are termed "precocious," and those to the latter, "nidicolous."

The precocious group includes all game birds, ducks, waders, gulls and plovers. They have proportionately large

eggs. The nidicolous group includes all perching birds, the birds of prey and others.

It is of considerable help, when watching birds nesting, to have a guide of the incubation and nestling periods. The table given below is built up largely from Witherby's *Handbook of British Birds:*—

| *Bird* | *Incubation Period* (*given in days*) | *Nestling Period* |
|---|---|---|
| Blackbird | 12–15 | 13–15 |
| Blackcap | 10–11 | 10–13 |
| Bullfinch | 12–14 | 12–16 |
| Chaffinch | 11–12 | 13–14 |
| Chiffchaff | 13–14 | 12–15 |
| Coot | 21–24 | Precocious |
| Creeper, Tree | 14–15 | 14–15 |
| Cuckoo | 12–13 | 20–23 |
| Dove, Ring (Wood pigeon) | 17 | 29 |
| Dove, Stock | 16–18 | 26–28 |
| Dove, Turtle | 13–14 | 18 |
| Flycatcher, Spotted | 12–14 | 12–13 |
| Goldcrest | 14–17 | 16–21 |
| Goldfinch | 12–13 | 13–14 |
| Greenfinch | 13–14 | 13–16 |
| Hawfinch | 9–10 | 10–11 |
| Hawk, Sparrow | 32–35 | 24–30 |
| Heron | 25 | 50–55 |
| Jackdaw | 17–18 | 30–35 |
| Jay | 16–17 | 20 |
| Kestrel | 27–29 | 27–30 |
| Kingfisher | 19–21 | 23–27 |
| Lapwing (Peewit) | 24–27 | Precocious |
| Linnet | 10–12 | 11–12 |
| Magpie | 17–18 | 22–27 |
| Mallard (Wild Duck) | 28 | Precocious |
| Martin, House | 14–15 | 19–22 |
| Martin, Sand | 14–15 | 19 |

| *Bird* | *Incubation Period* (*given in days*) | *Nestling Period* |
|---|---|---|
| Moorhen | 19–22 | Precocious |
| Nightingale | 13–14 | 11–12 |
| Nightjar | 18 | 16–21 |
| Nuthatch | 13–17 | 23–25 |
| Owl, Barn | 32–34 | 60–64 |
| Owl, Brown | 28–30 | 32–37 |
| Owl, Little | 28–29 | 26 |
| Partridge, Common | 23–25 | Precocious |
| Partridge, French | 23–24 | Precocious |
| Pheasant | 22–27 | Precocious |
| Pipit, Meadow | 13–14 | 12–14 |
| Pipit, Tree | 13–14 | 12–14 |
| Robin | 13–14 | 12–14 |
| Rook | 16–18 | 29–30 |
| Shrike, Red-backed | 14–16 | 14–15 |
| Skylark | 11 | 9–10 |
| Snipe | 19–20 | Precocious |
| Sparrow, Hedge | 11–13 | 15 |
| Sparrow, House | 12–14 | 15 |
| Starling | 12–13 | 20–22 |
| Stonechat | 14–15 | 12–13 |
| Swallow | 14–15 | 16–17 |
| Swan, Mute | 34–38 | Precocious |
| Swift | 18–19 | 42–45 |
| Thrush, Mistle | 13–14 | 14–16 |
| Thrush, Song | 13–14 | 13–15 |
| Tit, Blue | 13–14 | 15–21 |
| Tit, Coal | 17–18 | 16 |
| Tit, Great | 13–15 | 18–21 |
| Tit, Long-tailed | 14–18 | 15–16 |
| Tit, Marsh | 13 | 17–19 |
| Wagtail, Pied | 13–14 | 14–15 |
| Warbler, Garden | 11–12 | 9–10 |
| Warbler, Willow | 11–13 | 12–14 |
| Warbler, Wood | 13 | 11–12 |

| *Bird* | *Incubation Period* (*given in days*) | *Nestling Period* |
|---|---|---|
| Whitethroat .. .. .. | 11–13 | 10–12 |
| Whitethroat, Lesser .. .. | 10–11 | 11 |
| Woodpecker, Greater Spotted | 16 | 18–21 |
| Woodpecker, Green .. .. | 18–19 | 18–21 |
| Woodpecker, Lesser Spotted .. | 14 | 21 |
| Wren .. .. .. .. | 14–15 | 16–17 |
| Yellow Hammer .. .. | 12–14 | 12–13 |

The eggs of nidicolous birds are proportionately small, and the young remain a shorter time within the shell. They are, therefore, born in a less advanced state than precocious chicks and need much more care and attention from their parents. Generally speaking, they are hatched into a more carefully made nest that affords protection from cold as well as from enemies.

The respective parts played by male and female parents vary according to the species. In some, they share the incubation; in others the female does it all. Sometimes her husband brings her food as she sits, at others he goes off to enjoy himself with the other men. Drakes are notorious gad-abouts while their wives sit patiently at home. Blackcap fathers, on the other hand, relieve their wives at regular intervals, and do so with such apparent pleasure, that they sing as they sit!

It is usual for both parents to feed their young, and to protect them. Many birds feed the babies by regurgitation, at any rate for a few days after they are hatched. The parent swallows the food and then regurgitates it, partly or wholly digested, and passes it into the gapes of its offspring. Greenfinches, and probably others too, continue this practice even after the young have left the nest. I once watched the process carried out to perfection, as the following extract from my diary relates:—

"*July 6th:* Had a first-class view of a male greenfinch

feeding young by regurgitation. Two fully-fledged young were in an ash tree, and, on the approach of their parent, set up a loud clamouring. He went to one young bird and rammed a mass of white creamy stuff into its beak from his own. It came out so freely that it oozed from the sides of his bill; it appeared very thick and pasty in consistency.

"He continued to ram the stuff down the youngster until it began to ooze from *its* beak also, when the second young bird, who was not given any by Papa, pecked bits from his brother and collected the bits that dropped on to the bough. Both the father and replenished youngster then wiped their beaks on the bough."

In the case of cormorants and gannets, the young birds put their beaks inside the wide open mouth of the parent and help themselves to the fishy mess within the parental crop.

There is room for much close observation on all these interesting aspects of young birds, and any observations children can make should be carefully recorded at school.

A puzzling incident may sometimes be noticed when young birds are in the nest. The parent bird is seen to fly from the nest carrying in her beak what appears to be a small white egg. This she drops some distance away. It is not an egg, but the excreta of the young which is conveniently passed enclosed in a white membrane so that it may be removed without fouling the nest.

If you watch young birds in a nest, you may see Mamma arrive with food, distribute it as she thinks best among the clamorous brood, and then give a sharp little chirrup. Whereupon one small bird will up with its rear end to the edge of the nest and pass a capsule of excreta on to the rim of the nest. This the mother picks up and carries away. It is all most hygienic and keeps the nest beautifully clean.

Not all birds possess this desirable habit, but most *passeres* have it, the starling being a notable exception.

It is a pretty notion that the parent birds teach their babies

to fly, but there is no truth in it. Flight is instinctive, though infant wings naturally need exercise to make them strong. Young eagles, hawks, and owls do wing-flapping exercises as they stand in the nest, but one cannot picture a nestful of young thrushes besporting themselves thus! There would soon be trouble. Still less can one imagine the dozen or so long-tailed tits exercising either legs or wing muscles in their stuffy bag-like home.

Yet these birds are able to fly at least a dozen yards, and perch more or less successfully at the end of it, as soon as they leave the nest. I once witnessed this in an interesting way.

A pair of long-tailed tits had built their nest high in an oak tree in the garden. Just when the young were fledged, but had not yet left the nest, there was a terrific storm, and the nest blew down into a puddle. The parents flew around calling distractedly as I picked the nest up and carried it indoors to investigate.

Although very wet on the outside, the feathery-lined interior was quite dry, and I tore it open to see if the youngsters were still alive. They were indeed! All except one. They were extricated from the tangle of feathers and at once fluttered to the window. I opened it and they immediately flew, on as yet untried wings, to the shelter of a shed across the yard. Here their calls soon brought their parents to them with food.

### HIDES

Another aid to bird watching that may be made at school is a hide. This is a hut or tent-like erection placed near a nest. In it the observer conceals himself in order to watch the birds at the nest at close quarters. No serious ornithologist or bird photographer could get on without a hide.

It may be a purely temporary affair made of natural material. This is usually constructed piecemeal. A tangle of old wire netting may form the foundation. This is placed about four feet from the nest, and into it are stuck pieces of

gorse, heather, bracken or branches, according to the natural growth around. This operation must not last more than ten minutes, as the sitting bird will have left the nest in alarm, and will be awaiting your departure before she returns.

The next day the hide should be added to, with a peep-hole through which to watch operations, and shaped to accommodate one person. If the hide is not completed within ten minutes it must be left for a third visit.

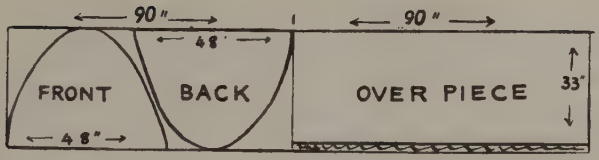
A tent hide is made at home and kept for use year after year. It may consist of a bundle of sacking or old material, a few sticks, a ball of string and some skewers, or it may be a carefully constructed round-topped tentlet in lightweight material as shown in Fig. 8. The birds will not mind which you use so long as it is not of a glaringly conspicuous colour, and is firmly fixed in position so that no part of it flaps in the wind.

When watching shy birds it is customary to erect the tent hide at least a dozen yards away first, and move it daily forward a few paces until it is as near as is required.

I once made and erected a hide of old curtains that had monkeys and parrots disporting themselves beneath a cheap green dye. Quite appropriate, I thought, to a woodland scene. So it was disappointing to find that it had been mistaken for a German parachute, at a time when an enemy landing was daily expected in the country; and I was subjected to the indignity of ringing up the local police station to explain matters and to beg for the return of my hide.

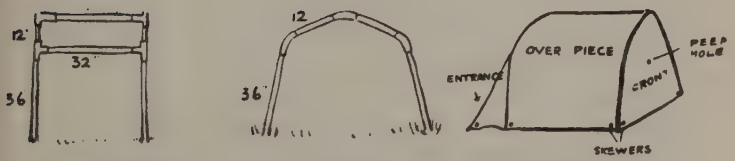
To make a lightweight hide that will fold into a seven-pound sugar bag, the following materials are required:—

5 yards of strong cotton material, 36 inches wide.
4 bamboo sticks, 3 feet long.
3 " " 2 feet 7 inches long. These are ridge sticks.
4 " " 1 foot long.
6 lead angles. It is wise to make one or two extra.
5 metal skewers. One or two extra are advisable also.




A. Light-weight Cotton Material 5 yds, 36 in. wide


B. Lead Angle




C. Frame: Side Front Hide Erected

Fig. 8. *A Lightweight Hide*

Cut the material as shown in Fig. 8A. Sew the long side of the over-piece to the round edge of the front. Do the same to the back but leave one side open as a doorway. Machine all hems and seams.

Fix small string loops to the corners and to the back flap, to peg the tent to the ground with skewers.

The lead angles are made from $\frac{3}{8}$-inch lead tubing used in electric wiring. Forty-two inches will be required altogether.

Cut a piece 4 inches long and pull out the wires. Hammer into a circular tube for a distance of $1\frac{1}{2}$ inches from each end. Flatten the middle inch.

Now cut a piece 3 inches long, and pull out wires. Make half this into a circular tube, and the other half flat. Bend the

flat end round the flat middle of the 4-inch piece, hammer well together and fix with two small nails. (Fig. 8B.)

To erect the hide, push the four longest sticks into the ground to form the corners. They should be 32 inches apart at the sides and 48 inches at the ends. On to the top ends of these place the angles. Join the sticks at each side with a ridge stick, and into the other end of each angle put a one-foot stick. These will meet at the top in pairs and be joined with the other angles and the third ridge stick put in place along the top. Over this the material is placed and pegged into position with the skewers. A peep-hole is cut in the front of the material. (Fig. 8C.)

Watching from a hide always involves two people. The watcher goes to the hide with a companion who acts as decoy. The bird will, of course, leave the nest. The watcher settles himself in the hide and the decoy walks ostentatiously away. The bird knows that when someone walks away, all is safe, so returns to the nest. It is, of course, essential that the watcher keeps as still as possible or the bird's trust in the hide as an inanimate object will be destroyed. Nor must the watcher come out of the hide until he is fetched by the decoy.

The time for the return of the decoy must be arranged beforehand, but there should be a signal arranged by which the watcher can stop the approach of the decoy if for any reason he does not wish to be disturbed. A red handkerchief may be put outside the back of the tent for this signal, to be replaced by a white one when the watcher is ready to be released.

The intrigue of all this should appeal very much to children and to older boys and girls, but the difficulty of keeping still for long in a cramped position is a very real one. Fortunately, most birds return at frequent intervals to feed their young, and it should not be necessary for children to stay in a hide more than about fifteen minutes in order to see at least one visit.

I have erected hides beside bullfinches' and whitethroats' nests from which a class of children, aged seven to ten, took turns to watch. The hides were high enough to allow the children to stand upright, and were erected within three feet of the nests. A relay of children attended upon these nests, always going in pairs and one returning alone, leaving the watcher for ten to fifteen minutes. During this time they saw the parents come, sometimes once, sometimes several times, to feed their young and remove the fæces. They learnt to recognize the cock and hen bullfinches and saw them regurgitate the food for the young.

Needless to say, the children were enthusiastic over the whole performance and recounted their observations with accurate detail on their return to the classroom.

## TAME BIRDS

Such close-up observations come second only to having a "tame wild" bird, if such a contradiction in terms may be used. By this I mean either a wild bird that is tame enough to come to the hand or into a room for food, or a wild bird that is reared by hand and given its freedom on "coming of age."

It is doubtful if many teachers will be willing to encourage robins and tits actually inside the classroom. They may be a real disturbance if they come too often, so perhaps the bird table or windowsill is the best place for them. But from time to time a sick bird may be cared for until tame, or a young bird fallen from its nest reared by hand—or hands, I should say, for everyone will be eager to help.

Members of the crow family—rooks, jackdaws, magpies, and jays—are reputed easy to rear, but are not easy to obtain, short of taking them from the nest, which procedure is contrary to the principles of nature teaching. Brown owls, like Barrie's infants who fall out of their prams in Kensington

Gardens, have a propensity to fall out of their nests. If one of these waifs should be found, it will make a most delightful pet.

An owlet may be kept in a rabbit hutch or hen coop with run attached, but it must be out of reach of dogs, cats, and live rats. It should be supplied with a bowl of water in which to bathe and a log on which to perch. It may be carried about in a bicycle basket, or on your shoulder, or tucked into your coat. It will allow itself to be petted and patted *ad lib.*, and may be used in the classroom to demonstrate (among other things) the correct method of swallowing a mouse, without the least embarrassment or class-consciousness.

As it grows up, it may be exercised in a barn or garage, and, when given its freedom, will return to your hand (if you have trained it) for food.

Feeding the owlet presents some difficulty, for it must have raw flesh and bones; fur and feather also. Every twenty-four hours it will cast up a pellet of this roughage. Butcher's meat, though useful in supplementing the diet, soon reduces the owl to a poor condition if given alone. Rats, moles, rabbits etc., must be cut into suitable pieces—a loathsome business best done on the chopping block. Children must be commissioned to bring dead mice, rats, birds, etc., and to rob their cats to feed the owl. This, in my experience, they do most willingly, if somewhat spasmodically, and with occasional lapses of memory.

The "before prayers" time, when children are arriving at school, is either hectically busy or pathetically empty for the teacher responsible for owl culture.

On Friday morning she looks wistfully round the cloakroom. All are absorbed in changing shoes, and no one so much as mentions the word "mouse."

"Nothing for Tootles to-day?" she enquires as brightly as possible.

"I did have a lovely fat rat for him," wails a small girl struggling into her overall, "but I've left it in the 'bus."

"And on Friday, too," mutters the teacher fiercely to herself. "How do the children expect me to feed their owl all the week-end if they don't do their bit?"

Life looks brighter on Monday morning. Unlocking the school door, she finds a small screw of newspaper pushed through the letter-box. A mouse from a neighbour.

Presently the children burst in. They are laden with flowers for Nature News, biscuits for lunch, dolls and other odds and ends.

"Here's a mouse for you, Miss ——, and you may keep the box," announces an important small person as he presents a large box containing a small shrew.

"Isn't it sweet?"

"Let me hold it!"

"Poor little thing; I wonder how it died?" and similar comments come thick and fast as the children crowd round.

A little girl draws a mouse out of a paper bag. It is white with flour. She hands it over, remarking, "Mummy wants the bag back."

A cocoa tin is thrust into the teacher's hand with the remark, "I forgot to give it to you last week." She opens it cautiously and hastily closes it again.

"My cat caught two mice, but they haven't got heads. *My* cat always bites their heads off." Another small boy presents a neat paper parcel tied up with yards of string, and there is sensation in the cloakroom as everyone clamours for a sight of the decapitated rodents. They are discovered to have their tails wrapped in blue tissue paper, as a ham is adorned with a frill. More sensation, and the cloakroom borders on bedlam.

The children are hurried in to prayers, and the teacher, finding herself dangling a bunch of mice by their tails as she hastily hunts for her hymn book, glances round the room

for a corner in which to hide them. Quickly she shoves them on a ledge behind the blackboard, where a little later they cause a fresh outburst of merriment by cascading to the floor in the middle of arithmetic. There are no dull moments when an owlet comes to school.

## SONG AND TERRITORY

Bird song is not easy to learn, but the very fact that it takes much perseverance and observation commends it as a worthwhile study for older children who have already some knowledge of birds.

The only way in which to become familiar with bird songs and calls is to stalk out each singer till you can recognize it by sight. Then to listen carefully to the song and try by some method to write it down. This obviously cannot be done by means of musical notation for the birds' scale has so many more notes in it than ours; such fine gradations, in fact, that they fit into no man-made scale and cannot be reproduced on any musical instrument.

Each student of bird song invents his own mode of expression for it. It may be expressed by means of wavy or zig-zag lines, with a spiral to denote a trill. Or it may be expressed by a few words which seem to catch the rhythm of the song. These are perhaps most helpful to children as they appeal to their sense of humour and are easy to remember. I give here a number I have found helpful. A few are original, but most have been collected from various sources, many now untraceable.

The song thrush sings each phrase at least twice:—

Get up, get up, get up!
Run along, run along!
Time for tea, time for tea.
Tea! tea! tea! tea!
Don't be late, don't be late.

The chaffinch's simple little song ends with a flourish expressed by the words, "Wheatear," "Kiss me dear," and "Ginger beer" in the following three interpretations:—

In a month or so will come the wheatear.
Will-o-will-o-will-o-will you kiss me dear.
Gin-gin-gin-gin-gin-gin-gin-gin ginger beer.

The greenfinch has three distinct parts to its song. It is termed its "trilogy" by Professor Garstang and interpreted thus:—

Twitter, twitter, twitter,
Chow, chow, chow, chow, chow,
Jeer . . . . . r.

The yellow-hammer's well-known lament about the cheese shortage is sometimes ended abruptly before the last word is reached, as if it were just *too* bad to mention:—

A little bit of bread and NO cheese.

The goldcrest, as it busies itself about the thick foliage of the fir trees, sings softly, as if to itself:—

I twist, and twist, and twist, and TWIST my nest together.

The blue tit's call note, "Tipsy gee-gee," is followed by a song I cannot express in words. It is a high-pitched trilling whistle:—

Si-si-si-sr . . . . . r.

The great tit's cheerful song, heard from January onwards, may be interpreted as:—

See-saw, see-saw, see-saw,

or:—

Teacher, teacher, teacher.

The chiffchaff reiterates its own name softly and monotonously, with here and there a variation in the vowel sound.

It should not be confused with the great tit's bold and strident notes:—

Chiff-chaff-chiff-chaff-cheff-chaff, etc.

The wren's boastful explosion of song has been amusingly interpreted thus by Charles Bayne:—

I sit, sit, sit, sit,
And sing, sing, sing, sing,
And trrrrilllllll
Who can sit, sit, sit, sit,
And sing, sing, sing, sing,
And trrrrilllllll
As I do?

Birds sing to proclaim their territory. Early in the Spring the cock begins to stake a claim to a certain piece of land on which he intends a family shall be reared. He perches here and there in his chosen realm, singing boastfully, stopping now and again to chase off an intruding male of the same species. He generally shows a preference for one particular branch from which he always sings his "dawn-song." It is probably close to his roosting place.

This territory business is most fundamental in its significance for it demonstrates that law of Nature which prevents overcrowding—*lebensraum*, we may call it.

A bird must have enough land of a suitable character. It must contain possibilities of obtaining sufficient food, not only for himself, but for his wife and family as each appears. Birds unable to find a suitable territory, must go elsewhere, and so, gradually, other factors being favourable, the range of a given species may enlarge. But the other factors are seldom favourable; that is to say, the population of any given species usually remains about stationary by reason of the mortality amongst young birds. Therefore there remains room for all breeding pairs within the geographical range of that species.

Side by side with proclaiming the territory and warning off rival males goes the attraction of the wife. Hearing the beautiful singer, she makes her way to him and allows herself to be wooed. Why birds sing so lustily at dawn and dusk is not quite clear, beyond perhaps the reason that they are busier with more serious affairs during the day; or perhaps it is sheer exuberance of spirits.

It will not be possible, except under such conditions as a school journey or camp, to arrange for children to hear a good dawn chorus. It is one of those treats better left until they are older.

Although they cannot hear the dawn chorus, however, they will like to know that birds have their regular times for going to bed and for getting up, and that they keep strictly to times according to species. But whereas a child goes to bed at, say, seven o'clock in the Winter and seven-thirty in the Summer, a bird goes to bed and rises according to sunset and sunrise. The sun is its clock. Thus in Summer it gets a very short night and in Winter a very long one. As there is much more work to be done in Summer no doubt this is a good arrangement.

Fig. 9 shows the proportion of the twenty-four hours devoted respectively to day and night by the robin.

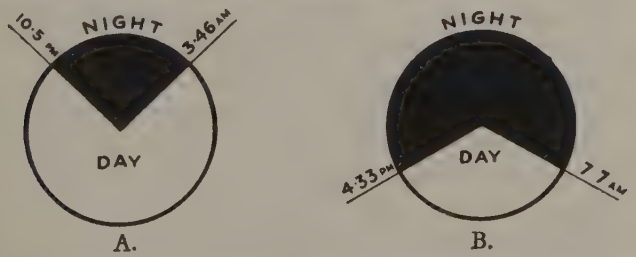



Fig. 9.—*Two "clocks" showing the proportions of the twenty-four hours allotted to day and night by the Robin. They were made after recording dawn and dusk choruses in a garden in Sussex.* A. *June 20th and 21st,* 1934. B. *December 20th to 21st,* 1934.

It is interesting to note, also, as one does after making notes on a number of dawn and dusk choruses, that certain birds (so like certain humans!) get up more punctually than others. It is a matter of habit with them, as it is with us, and it is the early risers who also go to bed late.

Amongst early birds must be counted the skylark, cuckoo, song thrush, blackbird, and robin, while notorious amongst sluggards is the jay. Tits and finches are what might be called "comfortable risers." Were they human, we should say they breakfasted at 8.30.

## SLEEP

Where do birds sleep? That is a question round which there is scope for investigation. Older children may go out on a Winter evening with torches and search nesting boxes, haystacks and wellingtonia trees for little birds tucked up for the night. Inspections of wellingtonias by day reveal small oval excavations about two inches long in the soft bark, and probably some bird-lime. Visited at night, they reveal tree-creepers and blue tits squashed into those shallow crevices—tiny bundles of fluff.

Wrens also like nooks and corners and will sometimes sleep many together. I have watched as many as seven or eight flit one by one into a martin's nest under the eaves of a house. One wondered how they all got in. In a crack in the plaster on my house a wren and a blue tit sleep together every night. Doubtless most birds sleep perched in bushes and trees, and sometimes they gather in large flocks each evening and sleep together. There is probably a feeling of safety in numbers. Wood-pigeons, rooks, and starlings are well-known examples of evening flocking, and their arrival at the roosting place is a spectacular sight, be it on the buildings round Trafalgar Square, where many thousands of starlings roost, or a lonely pine wood in the country.

The roosting trees of rooks are not those of the rookery, which is entirely deserted except during the nesting season. Redwings will foregather in a holly tree, meadow pipits in heather, and pied wagtails in a reed bed.

## MIGRATION

Much has been written about bird migration. Beyond looking out for the appearance in Spring of the first swallow, cuckoo, chiffchaff, etc., it is not a phenomenon that most children will be fortunate enough to watch in progress. They will ask many questions about it, however, amongst them the query, "How do we know where the birds go in Winter?"

Most of the information collected about bird migration has come from bird ringing or banding. Aluminium rings made in an easily graduated series to fit all sizes of bird legs are provided by various bird-ringing authorities. Chief among these in the British Isles is the British Trust for Ornithology, the headquarters of which is the British Museum (Natural History) London. Each ring is stamped with a number and "Inform British Museum Nat. Hist. London."

Only registered ringers may use these rings, but if children can be introduced to a ringer and watch him at work on a brood of nestlings, they will be intensely interested.

Of the number of birds ringed, only a very small percentage is ever recovered, but this is sufficient to tell the tale of migration. Children should be asked to examine all dead birds they find, and if one has a ring on its leg, post it with a letter explaining who found it, where, and on what date, to the address given on the ring. All rings are indexed and it is a simple matter for the secretary to turn up the date and place at which the bird was ringed and so discover how far it had wandered.

National interest in bird life is increasing and should continue to do so if wisely fostered in the schools, for it is

thus that persecution of birds will be stamped out. Most of all, perhaps, of all branches of natural history, can it be adequately studied in small groups or individually, though much encouragement may be given by classroom talks and lectures.

So when you have a wet afternoon and are unable to go for the appointed nature ramble, have a talk on one of these topics: Migration, Song, The Nesting Cycle, A Day in the Life of a Bird, A Bird's Year, the Classification of British Birds.

Get out your bird pictures, lantern slides, and, if you have them, gramophone records of their songs, and with the children enjoy a "Bird Orgy!"

### COLLECTIONS TO MAKE

Feathers. These are found most frequently from August to November when the birds are moulting. They may be sewn or stuck with stamp-paper on to stiff paper.

Nests. To be taken only after the birds have flown.

(NEVER collect eggs. Addled ones left in a nest may be kept a while, but do not generally stand blowing.)

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* Books written for children.

CHAPTER VI

# *The Quest for Insects and Spiders*

## REARING CATERPILLARS

THE SUMMER TERM is naturally the "caterpillar" term in the country, and it ought not to be difficult for any school within reach of a garden, allotment, or open country, to collect eggs or caterpillars of some kind to rear in the classroom. Birds may fly away, animals go to earth, but caterpillars will most obligingly carry on their normal routine and eat their way contentedly to maturity in any decently ventilated classroom, be the noise and chatter ever so!

On pages 98–100 is a table of butterflies and moths that may be successfully reared in the classroom. It is not by any means a complete list, for almost any caterpillar may be reared in captivity, but it is representative of the species most usually found.

A glance down the "Food Plant" column of the table shows that all are common plants, though some are local. It is a good plan to visit these "locals," buckthorn and alder buckthorn, greater willowherb, heather and ling, at the time at which the eggs may be seen, and search upon their leaves. Year after year the same clump of alder buckthorn may be relied upon to yield brimstone butterfly eggs, and a female brimstone (distinguished from the male by a paler colour) may be seen to lay the egg. If this is taken back to school (still attached to the underside of the leaf on which it was laid, of course) its development will be watched with particular interest.

Eggs and very tiny caterpillars are best kept in a box with a glass slip over the top. They need no air holes, but great care should be taken that they are not exposed to sunlight through

# TABLE OF BUTTERFLIES AND MOTHS TO REAR IN THE CLASSROOM

| *Name* | *Food Plant* | *When Found* | *Pupa* | *When Imago Emerges* |
|---|---|---|---|---|
| BUTTERFLIES<br>Large White | Cabbage and other brassicas. Mignonette | Eggs in May and June; second brood in July and August | Suspended from food plant or lid of cage | August; second brood following May |
| Small White | Cabbage and other brassicas. Mignonette and nasturtium | Eggs in May and again in July and August | Suspended | July; second brood following March and April |
| Orange-tip | Cuckoo-flower (*Cardamine pratensis*) and hedge mustard (*Sisymbrium officinale*) | Eggs on flower-stalks of food plant in June | Suspended | Following May or June |
| Brimstone | Buckthorn and alder buckthorn | Eggs found latter half of May | Suspended | Late July |
| Comma | Nettle and gooseberry | Eggs in April and May. Caterpillars May and June (e.g. found when picking gooseberries) | Suspended | July |
| Peacock | Nettle | Eggs and caterpillars in May. Gregarious | Suspended | July |

## TABLE OF BUTTERFLIES AND MOTHS TO REAR IN THE CLASSROOM—*continued*

| *Name* | *Food Plant* | *When Found* | *Pupa* | *When Imago Emerges* |
|---|---|---|---|---|
| Small Tortoiseshell | Nettle | Eggs and caterpillars in May. Gregarious | Suspended | July |
| Red Admiral | Nettle | Eggs and caterpillars in June | Suspended | July and August |
| MOTHS<br>Gold Tail or Yellow Tail | Hawthorn, rose, apple, pear, etc. | Eggs laid in August. Caterpillars hibernate and reappear following May, when they are usually found nearly full grown | Chrysalis enclosed in silky and hairy cocoon on food-plant or side of cage | Late June or July |
| Vapourer | Many trees, including plane | Eggs laid on outside of cocoon in Summer, remaining thus till following May. Caterpillars found May to August | Attached to wood, e.g. side of cage | July to September |
| Pale Tussock | Oak, hazel, lime, hops, etc. | Eggs in June. Caterpillars July to September | Silken cocoon amongst leaves of food plant | Following May |
| Buff Tip | Oak, hazel, elm, and other trees | Eggs in June. Full-grown caterpillars found crawling on the ground in August and September | Under dead leaves or roots of grass. Put these in earth-box in cage | Following May or June |
| Cinnabar | Ragwort and groundsel | Eggs and caterpillars found in large companies in June | On the ground or just beneath surface. Give earth-box | Following May |

## TABLE OF BUTTERFLIES AND MOTHS TO REAR IN THE CLASSROOM—*continued*

| *Name* | *Food Plant* | *When Found* | *Pupa* | *When Imago Emerges* |
|---|---|---|---|---|
| Garden Tiger | Hollyhock, deadnettle, and many other plants | Eggs in July. Caterpillars (full grown) in following May and June | Silken and hairy cocoon amongst herbage | July |
| Puss Moth | Poplar and sallow | Eggs in June. Full-grown caterpillars in August | In a crevice in rough bark. Put a piece in the cage | Following May |
| Emperor Moth | Heather, ling or bramble | Eggs in May. Caterpillars throughout Summer (e.g. when picking wortle berries) | Chrysalis enclosed in silken cocoon entwined in food plant or against side of cage | Following April |
| Elephant Hawk | Greater willowherb | Eggs in June. Large caterpillars in August and September | In the ground. Give earth-box | Following June |
| Lime Hawk | Lime and elm | Eggs in June. Large caterpillars in August and September | In the ground. Give earth-box | Following May |
| Privet Hawk | Privet. Occasionally elder and lilac | Eggs in June or July. Large caterpillars July to September | In the ground. Give earth-box | Following June |
| Poplar Hawk | Poplar, willow, Laurestinus | Eggs laid in May and again in July | In the ground. Give earth-box | May eggs emerge in July. Those laid in July, the following June |

the glass. Whole broods have been dried up by the sun getting round on to the windowsill on which they were kept. A small, soft paint-brush should be used for moving the caterpillars from the stale food to fresh each day, and care should be taken not to smother them in too many leaves. Children are very apt to do this in their enthusiasm.

In hot weather it may be necessary to change the food twice in the day as it soon wilts if not in water. The food should be neither wilted nor wet, so it is best to keep some sprays of the food plant in water ready for use in wet weather.

As soon as the caterpillars are too large to escape through the perforated zinc, they may be transferred to cages, several of which should be made in readiness for the Summer term. Now the food plant may be kept in water in the cage, care being taken to cover the water pot so that the caterpillars do not fall in. The water pot should be as small as possible, and it is advisable to leave a little of the food plant on the floor of the cage in case a caterpillar falls and cannot regain the plant in the pot. Although it will not be necessary to change the food plant so often now, the caterpillars should be examined each morning, and refuse cleared away.[1]

A caterpillar cage may be made of any wooden box. Stand it on its side, take out the bottom (now the front), and passe-partout a piece of glass in its place. Take off the top (now the back) and fix perforated zinc neatly and securely in its place with drawing pins. An excellent cage may be made from a glass-fronted fuse-box. This has no back as it was originally fixed against a wall, so cover it with perforated zinc as before and the job is finished.

For rearing a number of caterpillars of the same kind, for instance, small tortoiseshell or peacock, the simplest method is

[1] Although this is the method adopted by the author, L. Hugh Newman, F.R.E.S., the "Butterfly Farmer," says it is better to gather fresh food each day, as leaves kept in water too long become water-logged and may upset caterpillars as wet food does. Doubtless he is right, but where food is not easy to get it *is* possible to keep it in water a few days without harm

to keep them in a large aquarium or other glass container (such as an old accumulator jar), with muslin fixed on the top with a rubber band. Again care must be exercised to prevent the sun shining relentlessly for long periods through the glass.

If a caterpillar crawls away from the food plant and appears listless, it is probably about to change its skin or to pupate. Do not disturb it, as one over-anxious class did. They were convinced that their comma caterpillar was stuck to the lid (as indeed it was!) so helped it down, with the result that it lay, apparently lifeless, on the floor of the cage for several days before pupating. Actually it had been attaching itself firmly to the roof by a silken pad preparatory to pupation, and it must have hurt not a little to be wrenched down by childish fingers.

It is worth watching the transformation from larva to pupa, especially in those which are suspended. The brimstone makes a tiny silk hammock with which to support its body. Its last action is to cast its skin, and there, as if by magic, is the almost transparent leaf-like pupa of delicate apple green! Children may be shown the different parts of the body in the pupa, and should be constantly on the watch for emergence. This is apparent by a change of colour in the wing part, as the newly-formed wing within shows through the chitinous skin. The tail-end also twitches if touched.

To describe adequately the emergence of a butterfly is beyond my powers. It must be seen to be appreciated and is one of those æsthetic opportunities that should be made possible for all children to enjoy. On one occasion, a number of peacock butterflies were emerging on the same day. As each one struggled forth, it was lifted out of the cage and put on the top to stretch its wings. Soon the classroom was filled with butterflies flitting about, and the windows were flung open and the lovely creatures guided into the open air.

A comma had emerged one day, and was taken into the garden to be given its liberty, the children following eagerly to watch its first flight. Stretching its coppery wings it took off

from my hand, but as we watched it fly, down swooped a fly-catcher, fluttered a moment and was gone—comma as well! There was a groan of astonished disappointment from the children and exclamations of ". . . and it only flew *so* far!"

We had a late brood of tortoiseshells one Autumn term. These emerged small and intense in colour, and, after flying a short time indoors, hibernated in dark corners. One was discovered in the folds of a little victory flag made by a child, and others in the curtains. The next Spring we were able to recognize "our" tortoiseshells as they awoke and made their way into the sunshine.

One September a small boy brought in an emperor moth caterpillar which he had found on heather during the holidays. This spun its flask-shaped cocoon complete with hairy trap-door, and remained thus till the very last day of the Spring term when, just as good-byes were being said, it was discovered to have emerged. It was hastily passed round for all to admire the handsome moth, and to notice the soft colouring and only slightly feathered antennae of the female. The moth was kept by the kindergarten teacher, and after five days, two males appeared. One of these was allowed entry, and mating took place immediately, and occupied half-an-hour. Three hours later eggs were laid, and the female, being now restless, was given her liberty. After eighteen days the eggs hatched (on May 2nd). Two caterpillars were successfully reared through the Summer term, and on August 1st pupation began. This occupied eight days, during which time each caterpillar could be seen spinning its cocoon around itself and could be heard rustling within. Finally they changed their skins for the last time and became quiescent chrysalids. The moths emerged on almost the last day of the coming Spring term, and, being males, were allowed their freedom at once.

Rearing caterpillars is the systematic work of the nature table, but many and varied, not to say exciting, are the other adventures one may experience with insects during the Summer term.

"We have a white admiral. It haunts us at Arithmetic," wrote a small girl in her Nature diary. Quite true! it did. For we sat daily at our desks under the oak trees that merge garden and forest.

"Look Michael, there's a green butterfly on your blazer!" This in the middle of History. But Michael was the only one who did not get a good look at the green hairstreak, for it was in the middle of his back!

### BEES, WASPS, AND OTHERS

A large wooden shed has been converted into a verandah-like classroom for Summer time, and this, with its old beams and holes and crevices, is a perfect paradise for many insects, including the brilliant little ruby wasp, which has been seen running swiftly along the woodwork in the hot sunshine, blazing with a metallic green, red, and gold.

One year a queen wasp began to build her nest from a beam over my (the teacher's) desk in this classroom. She had not got far when we discovered it, and it was possible for the class not only to watch her adding on layers of papier mâché, working round and round the dome with her jaws, but also to follow her to the deck chairs on the lawn, and to see her scraping off the fine wood and carrying it rolled in a tiny ball under her "chin" back to the nest. During wet weather she spent her time inside the nest, where she constructed at first seven cells (one central one with six round it, all hexagonal), and then proceeded to add more around these. She was difficult to see inside, but would emit an angry buzz if the nest was touched, sending the children scrambling to their desks! We were debating whether to remove wasp's nest or class—there would not be room for both once the workers got going—when activity ceased and the queen was found dead on the path outside.

Just at this time another nest, in a slightly more advanced stage, was cut out of a hedge, and as the queen had gone, we

opened it up for examination. Here we found all stages of development in the cells—eggs, young larvae, full-grown larvae, larvae in the act of sealing up the top of the cell, pupae, and full grown worker wasps (albeit pale creatures for want of light) about to emerge. A few of these cells we kept, making a little paper case around them, and feeding the larvae on a solution of sugar and water. Fabre describes how a wasp, when feeding the grubs, gives each one a drop of nectar in its mandibles and a second drop on its "bib" or "double chin" thrust out to receive it. This the grub is left to lap up while the wasp attends to others of the many hundred offspring; an ingenious labour-saving device!

A pinhead served as a dropper for the sticky fluid for our baby wasps, and much amusement was derived from watching them thrust out their fat white "chins" for the second drop, while their tiny brown mandibles worked from side to side manipulating the syrup.

Leaf-cutter bees are fascinating creatures; we had these also in a crack in the roof over my desk. While we could see the bee come in with pieces of leaf, we could not, short of pulling the roof off, see the cells. But a friend who had leaf-cutter bees every year in flower-pots in her greenhouse, kindly invited us there to watch them. Posting children at various vantage-points from greenhouse to rose-bed, we were able to track the bee, watch her cut oval or round pieces of leaf (according to whether she wanted them for the side or end of a cell), and return with them to the flower-pot. Moreover, we were given a pot containing a number of cells which we kept till the following Spring, when the young bees emerged. We could then dissect the cells and see how the oval pieces of leaf had been wrapped round the sides and the round ones plugged up the ends, and how the top end was concave and the bottom convex, so that the cells fitted into one another, end to end.

Oak marbles fascinate children, especially when they are

shown the tiny room within, and the passage by which the perfect insect, a kind of wasp, emerged. Sometimes we keep oak marbles that have not yet got holes in and see the insect that comes out. Often on nature rambles we find oak marbles that have been torn open by tits for the sake of the juicy morsel within.

How we envy the frog-hopper his cool "bubble-house" (cuckoo-spit) on a hot summer day! And how gently do the kindergarten children open up the bubble to peer at the pale, soft creature within, and then hastily cover it again lest the hot sun should hurt it.

Greenfly and ladybirds: these generally go together in our studies, for the ladybird larvae feed on green and black fly and, as these are prolific on roses and beans, our ladybirds have a good time. They may be reared during the Summer term, and the newly-emerged ladybirds returned to the rosebushes.

### SPIDERS

"Why don't you write about us?" ask the spiders.

"But you're not insects, you know," I reply.

"But you watch us and play with us, and we do lots of interesting things, too."

Quite right. So they do, and I must let them creep in here in their spidery fashion.

Few children are frightened of "creepy-crawlies," and those who are, soon overcome their fears by interest. We have actually watched a garden spider spinning the foundations of its web from a boy's outstretched arm, and could see the threads stuck in position, the lines paid out and drawn taut. We have felt gossamer in our faces, and heard the story, as good as a fairy tale, of the thousands of tiny spiders who, wanting to see the world, climb to the tops of fences and other exposed positions, and, paying out several silken threads, stand on tiptoe and float away on the wind on their parachutes. How high they go or how long their journey lasts we cannot

say, but it is no uncommon sight to see the lawn completely covered with a silken carpet from the fallen parachutists.

We have found spiders' nurseries (full of babies!) and have watched anxious mother spiders hastening from us with egg cocoons almost as large as themselves.

We have peered breathless down the tunnel of the tube-building spider to see the hairy monster lurking in the darkness amongst the broken limbs of those unfortunates he has torn to pieces. Then we cry aloud to the flies to beware, and tenderly rescue bluebottles from the cunning snares.

Once we discovered a fairy lamp, the little white cocoon of the spider of that name, made in the shape of a lantern and hung from a blade of grass. Yes, indeed, there is something faerie about spiders, most appealing to little children.

## POTTED LIFE-HISTORIES

Now I have outlined a variety of observations made by children (there are many others as readily obtainable in a country or semi-country area), but what are the children to gain from all they have seen?

First of all they need explanations, and pointers from the teacher as to what to look out for. This means little talks, sometimes in the field, sometimes in the classroom with a blackboard. Five-minute talks are often given at the beginning of school the morning after something of special interest has been noticed—after I have had time to read up something about it!

For the most part the teacher will have to do the reading, and be prepared to interpret it in a simple, graphic way to suit the age of the child she is dealing with.

For this reason I add here further short notes on some of the insects already mentioned, and on others commonly seen but whose life-histories and little peculiarities are seldom adequately described in popular books on natural history. No description is given of the appearance, except in a few

cases, as it is assumed that either the insect or its work has been already recognized. Latin names are given as well as the English ones to enable the student to trace them in more scientific works. English names are apt to be loosely applied (for instance, mason and sand wasps are confused in name in different books), but their Latin names specify them exactly.

### LEAF-CUTTER BEES

*Megachile argentata* burrows in earth, and *Megachile centuncula* bores holes in decaying wood.

*Life-history*

Cells are made in early summer and an egg laid in each. This is packed with honey and pollen and sealed up with several layers of circular rose-leaves. In all, about six cigar-like cells are made and placed end to end. The eggs hatch and the grubs feed on the food supplied, then pupate until the following Spring. Those in the top cells, though laid last, emerge first, and are males. They make their escape into the air, and the females from the lower cells climb up through the now empty upper cells and also emerge to begin a new cycle.

### MASON WASP AND RUBY WASP

There are several species of each of these, the commonest being the mason wasp (*Odinerus spinipes*), which is preyed upon by the ruby wasp or fire-tail (*Chrysis bidentata*). Another pair is *Odinerus parietum* preyed upon by *Chrysis ignita.*

*O. spinipes* seeks sandy banks and *O. parietum* old masonry.

It is not necessary to differentiate between these with children, the position of the holes of the mason wasps being sufficient identification.

*Life-history of* O. spinipes

In June the female mason wasp tunnels into the bank for several inches, making a tower of the sand withdrawn from

the inside. This tower curves downward. An egg is laid near the bottom of the tunnel, which latter is then filled with paralysed caterpillars of a certain beetle. The tower is broken down and the top sealed up with the remnants of it.

On hatching, the grub feeds on the caterpillars, finally pupates and remains thus till early Summer next year.

The ruby wasp likes to creep in unobserved when the cell is newly made to lay its egg in there. This, on hatching, eats, not only the paralysed caterpillars, but the young mason wasp too.

A fascinating illustrated description of these insects is written for children by Douglas English in his *Book of Nimble Beasts*.

### FROG-HOPPER (*Philœnus spumarius*)

Is nearly allied to the aphis or greenfly.

*Life-history*

Eggs are laid in crevices of willow bark in Autumn. The larvae hatch the following Spring, make their way to green herbage and live and grow by a series of moults within their bubble houses, until by July they are ready to pupate. This they do also within their bubbles. The bubbles now gradually evaporate, by which time the frog-hoppers are full grown, cast their skins for the last time and emerge, perfect insects with wings.

*Peculiarities*

Cuckoo-spit is formed by the beak of the larva sucking up sugary sap of the leaves and passing it through its body, where the surplus fluid is whipped with air by a special air tube as it passes out of the food canal. A small quantity of wax is secreted by the body and this, plus the sugar, sap and air, ferments into a soap which remains bubbly even in hot sunshine.

### LADYBIRD

There are several species of the family *Coccinella*.

*Life-history*

Eggs are laid on leaves of roses and other plants harbouring aphides, in early Summer. The larvae are attractive in their blue-grey suits spotted with golden yellow. They feed on aphides, sucking their juices and leaving empty skins and limbs only. After a few weeks they pupate in a little brown cocoon on the food plant, and a few weeks more sees the ladybird proper emerge. This also feeds on aphides.

*Peculiarities*

In years of bad infestation of green and black fly, swarms of ladybirds have been known to cross the Channel to join the feast. For this reason this attractive little beetle should be encouraged and looked upon as a benefit to the garden.

Cochineal is made from a foreign species of ladybird.

*Classroom activities*

Ladybird larvae may be satisfactorily kept in a glass-topped box, an abundant and constant supply of aphides being the only necessity. Their life cycle may be watched in one Summer term.

### GLOW-WORM (*Lampyris noctiluca*)

A beetle, the female of which resembles the larval form in having no wings or elytra.

*Life-history*

Eggs are laid in early Summer in moss or damp grass. Larvae feed voraciously on small snails, injecting them with a poisonous secretion which renders them soft and easy to swallow. Larvae hibernate for the winter and continue to

feed and grow the following Spring. The pupa is still slightly mobile. The perfect insect emerges in early Summer. In this stage it eats little or nothing.

*Peculiarities*

Although all forms and stages of this insect are slightly luminous, it is the wingless female which shines the most light in order to attract the male. For this purpose she climbs up amongst the herbage and turns up her tail to expose the underside, which bears the luminous patch. She can control the glow apparently at will, and it is difficult to induce her to "put up a show" in captivity.

## PILL BEETLE (*Byrrhus pilula*)

This is the size and shape, when legs and head are withdrawn, of a rabbit dropping.

*Life-history*

The female makes a vertical hole in the ground in Spring, often on a woodland path which rabbits frequent. It is just large enough to take one or two rabbit "pills." In these the eggs are laid and on them the grubs feed. After pupation the perfect beetle appears up from the hole.

*Classroom activities*

The pill beetle may be kept in a box of light earth not less than six inches deep. Supply it with rabbit droppings, and keep the box covered with a glass top. The beetle may then be watched making its hole and carrying the "pills" into it. To watch the life-history, remember to keep the earth slightly damp, but never drenched or sun-baked. (This applies to any insects kept in earth.)

### DADDY-LONG-LEGS

There are several species of this family *Tipulidæ* or crane-flies.

*Life-history*

Eggs are laid in early Autumn in damp earth. In about fourteen days the larva is hatched. This is known to gardeners and farmers as the harmful leather-jacket which feeds on roots of grass and vegetables. In early Spring it pupates in a vertical position, the upper end at ground level. Thus it remains all Summer till August or September, when the perfect insect emerges.

There is a species of the daddy-long-legs that lays its eggs in damp, rotten oak boughs. These larvae, like other crane-flies, are legless, and have a concertina-like movement of the segments of the body. They are white and fleshy. They may be kept in the classroom in their damp wood, and will pupate in early Spring in brown cocoons, and soon after emerge.

### EARWIG (*Forficula auricularia*)

Allied to cockroach, cricket, and grasshopper.

*Life-history*

Eggs are laid in a cluster on or just beneath the surface of the earth in Summer. Young hatch in a week or two and these resemble the adult form except that they are wingless. There is no quiescent pupal form.

*Peculiarities*

The mother earwig watches over the eggs and young and appears to cover them with her body as a hen does her chicks.

Although possessing wings, earwigs seldom fly. The pincers at the rear are capable of perceptibly pinching a

human being but the pain soon passes. They are also used in capturing insect prey and in mating. It is pure superstition that earwigs show a preference for ears and noses!

It is nocturnal in habits.

### CENTIPEDE

There are several species belonging to the family *Lithobus* in the order *Chilopoda*. This and the millipede are not, strictly speaking, insects, having many structural likenesses to both insects and spiders and a few to the crustaceans. They belong to the class *Myriopoda*.

*Life-history*

Eggs are laid in Spring, each one separately and rolled in earth to make it inconspicuous. On hatching they resemble the adult form in miniature, with fewer pairs of legs. At each moult more legs appear.

*Peculiarities*

The centipede can pinch with the front pair of legs (claws), injecting a small amount of poisonous fluid. This is not sufficient to harm a human, but is used effectively in preying upon other small creatures, particularly the earthworm. It is nocturnal. It has fifteen to twenty pairs of legs, not a hundred, as its name suggests!

### MILLEPEDE

Two genera are common in Britain, the common millepedes (*Julus*) and the pill-millepedes (*Glomerus*).

*Life-history*

The female builds a nest in Summer. It is about the size and shape of a marble and consists of grains of earth cemented together with saliva. Leaving a hole in it, she drops into it a

number of eggs, then seals it up and leaves it. The young hatch in about a fortnight, and have then only three pairs of legs. More appear at each moult.

*Classroom activities*

Millipedes may be kept in damp earth in a glass-topped box. They should be fed on young green leaves, grass, and little pieces of apple.

### LEAF ROLLERS

There are several weevils (species of beetle) that roll their eggs in the leaves of various trees. Those found on hazel or birch are perhaps the commonest.

*Life-history*

Eggs are laid in early Summer, the leaf being rolled up to form a cigar-shaped tube. According to the species of weevil the leaf may be wholly rolled, compactly and conically; or the leaf may be cut across near the base to the mid-rib and either one or both sides rolled to the centre; or it may be rolled from one side only, not making use of the entire blade. On hatching, the grubs feed within the coiled leaf until ready to pupate, when they leave their cradle and bury themselves in the ground. Here they may remain a matter of weeks, emerging in late Summer.

### LEAF MINERS

There are many insects, mostly flies and minute moths, that lay their eggs in the tissues of growing leaves. The larvae, on hatching, feed on the leaf, making for themselves a chamber between the upper and lower epidermis. This causes discoloration, generally a paling where the tissues have been eaten away. This is sometimes in patches, sometimes in irregular serpentine channels, according to the species of insect at work.

Children will enjoy finding the burrows in blackberry, beech, honeysuckle, and other leaves. The following quotation from a child's written observations tells exactly what interests him most:

"There is a funny little kind of moth that lays its eggs near the main vein (of the beech leaf). When the egg hatches into a little grub it feeds on the inside of the leaf. There is a skin on the top and bottom of the leaf, and soft stuff inside. The grub feeds on this. As he does so he makes a tunnel. You can see this for yourself, for the leaf stays green where he is. He makes a tunnel that starts very small and gets bigger and bigger because he is growing."

Little patches of dark matter left in the "mines" consist of the larva's excreta.

It is not often easy to see the larva at work but the one that makes large patches in sorrel leaves is quite apparent in September and will wriggle if touched. At the end of the month it leaves the sorrel leaf and pupates in the earth. It may be kept in the classroom successfully.

Most leaf miners' work is apparent in Autumn, when the part *around* the mine often remains bright green after the rest of the leaf has turned brown. Leaves containing mines may be kept in corked bottles and watched for the emergence of the perfect insect, but as it is not easy to keep them at the correct dampness throughout the Winter, it is often better to collect a few in April, when they will only need care for a short time before they "come out" in May.

The larva of the tiny fly *Hermomyia peligera* excavates a little patch in a beech leaf. Irritation causes a hairy lump or gall to arise on the upper surface, and this the pupa conveniently uses as a cocoon. These may be commonly found in Autumn.

## GALLS

These are many and varied and the life-histories of some are complicated. Nevertheless they are ubiquitous at certain seasons and quickly attract the attention of children by their quaint shapes and bright colours. A few only can be touched upon here. All of these are caused by an insect having laid its egg or eggs in a bud, stem or leaf. This has so irritated the part as to cause sap to be rushed up and the plant to grow a swelling of some form or another around the egg. In this and on this the grub lives and rests until it emerges a perfect insect.

### ROBIN'S PINCUSHION

Caused by the fly *Rhodites rosæ*. Many eggs are laid together causing the resultant swelling to contain many grubs. The eggs are laid in Spring and the gall is at its best in August and September, after which it is apt to turn a dingy brown. Full-grown flies emerge the following Spring.

### WITCHES BROOM

Most common on birch, sometimes seen on beech (generally around the bole), and on fir and scots pine. Caused by an irritation in a bud, may be by an insect or a fungus growth. Twigs coming from a "broom" bear leaves, and sometimes flowers, but both are frequently stunted and malformed. It causes no further damage to the tree.

### OAK MARBLE

Caused by the gall-wasp *Cynips kollari*. Each marble is the cell of one wasp only.

*Classroom activities*

Collect oak marbles and sort them into two groups, those with a hole and those without. Cut carefully through the

hole of one and expose the tunnel joining the circular cell in the centre with the outside world. Cut open also a marble without a hole. Do this so carefully that the larva or egg is exposed to view without injury.

Keep a number of unopened marbles under a glass jar and watch for emergence. This will probably take place in October.

Experiment in dyeing with marbles.

### OAK APPLE

Caused by the gall-wasp *Biorrhiza terminalis*.

*Life-history*

Eggs are laid by a wingless female in the terminal leaf-buds in Spring. These expand into a spongy mass on which the larvae feed. In June they pupate and a little later bore their way out as winged insects. These are of both sexes; they mate, and the female bores her way into the earth at the base of the oak tree and lays eggs on the rootlets. These form single-celled galls, but being close together, fuse into a mass. The eggs within hatch, the grubs feed and pupate, and finally emerge during Winter as the wingless females who lay eggs in the terminal leaf-buds. These wingless females need no fertilization and there are no males at this time of year. See Fig. 10.

### CURRANT GALL AND COMMON SPANGLE

There are more than fifty kinds of galls to be found on oaks alone, and of these the bulk are on leaves or twigs. It is beyond the scope of the junior school to do more than give popular names to some, but the double cycle of the currant-spangle galls is interesting as comparative with the alternate generations of the oak apple just referred to.

The currant gall is caused by the fly *Neuroterus baccarum*, and the common spangle-gall by *Neuroterus lenticularis*.

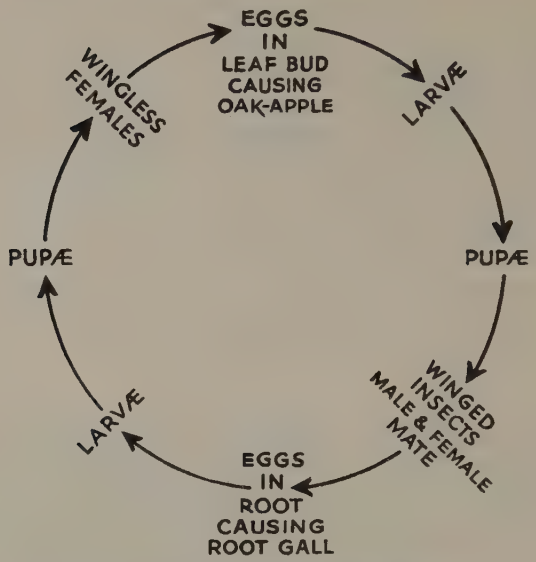


Fig. 10.—*Life Cycle of Biorrhiza Terminalis.*

*Life-history*

The currant galls appear with the male flowers in late May or early June. From them emerge the flies which puncture the oak leaves and lay their eggs within. These produce the common-spangle galls in late summer. The galls eventually fall from the leaves, curl backwards to enclose the larva completely, and remain among the dead leaves on the ground all Winter. On emergence in Spring, the fly flies up to the flowering catkins and the cycle is repeated.

### PINE-APPLE GALL (*Chermes abietes*)

This is found on spruce firs and is caused by an aphis. It resembles a cone at the tip of the stem.

*Life-history*

Eggs are laid in the terminal bud and irritation causes the growth of the gall above them. The aphis larvae crawl up the outside of the "pine apple" and enter it through little valves which may easily be seen on its upper surface. Inside, the aphis pupates.

## SPIDERS

There is no definite larval stage in the development of spiders. Eggs are enclosed, a number together, within a silken egg cocoon. Sometimes these are exquisite architectural structures, particularly the fairy lamp (*Agroeca brunnea*) mentioned earlier in this chapter.

Baby spiders usually remain together and may be guarded by their mother, until after the first moult, when they quickly disperse to avoid being eaten by their parent or each other. Before the first moult they eat nothing.

### GARDEN SPIDER (*Araneus diadematus*)

The maker of the orb web.

*Life-history*

Eggs are laid in September or October in a cluster enclosed in a yellowish cocoon and attached to wood; for instance, in the crevice of the bark of a tree. The eggs generally hatch in November, but may rest until Spring if the weather is severe. Baby garden spiders are golden yellow till after the first moult, when they become brown. They cluster together amongst a mass of silken threads.

*Peculiarities*

Early Autumn is the best time of year to see the orb web of the garden spider. Like some other species, the garden spider makes use of a "telephone" or thread which runs from

the web to the place where she is hiding. When any disturbance occurs in the web, the vibration runs down the telephone thread and the spider, on feeling it, runs out to find the cause, perhaps a bluebottle.

### WOLF SPIDER (*Lycosa*)

A wandering spider making no snare.

*Life-history*

Eggs are laid in a ball-like cocoon rather larger than the mother's abdomen. It is carried by her on the underside of her body, being attached to the spinnerets. When the young hatch they cling to her hairy back for some days. This may be seen in Summer.

*Peculiarities*

The males indulge in an elaborate courtship, raising and lowering their front pair of legs and waving their antennae in front of the female. Later in the season, however, if the female meets her husband, she eats him!

### ZEBRA SPIDER (*Salticus scenicus*)

A jumping spider, catching its prey by creeping up near it and then pouncing like a cat. It may be seen running about on sunny walls and fences—a small, short-legged spider with zebra markings.

Both zebra and wolf spiders belong to the group of hunting spiders. Though making no webs, they are capable of producing silk and use this for "pay-lines" and (in the case of the zebra) for wrapping round a fly so as to make a silken parcel of it to offer to his mate!

In summing up the work done on insects through the junior school, it is most important that the mass of informa-

tion and observations be sorted out and classified. This may be done towards the end of the Summer term with the ten- and eleven-year-olds. They are ready for it then and it makes an excellent revision and summary. They may write lists and comparisons, draw labelled diagrams, and feel very grown-up and learned! Of course they haven't discovered everything mentioned in this chapter in one term, but probably in the course of a child's time in the school they have covered most of it, or made observations on other types of insects equally interesting, so that by now they should have grasped the following biological information:—

The difference between an insect and a spider.

The difference between a moth and a butterfly.

Life-histories and feeding habits of:
- Butterflies and moths.
- Bees and wasps.
- Spiders.

Mating and egg-laying.

The division of the insect's body into head, thorax and abdomen.

The appendages (legs, wings, antennae), their number and place of attachment.

The position of the breathing apparatus (spiracles) and silk-producers (spinnerets).

The exo-skeleton, and the need for changing the skin during growth.

The form of the body during larval and pupal stages compared with that of the imago.

### COLLECTIONS TO MAKE

Chrysalises and cocoons of butterflies and moths reared in the classroom. (NEVER kill butterflies and moths for collection purposes.)

Galls.

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CHAPTER VII

# *The Quest for Pond Creatures*

THE APPEAL OF WATER and of "fishing" is so universal to the young as to require no explanation or justification. If children are refused the opportunity for such exercise, they will indulge it, willy-nilly. And why not?

I have seldom seen children more excited than when pond dipping. They race round the pond with their dripping nets held aloft and splash muddy water all down your front in their eagerness to show you their haul, and beg you to put it in their jam-jar as they are afraid to touch it! Considering the habits nets have, when wet, of licking people's faces or dropping on to their heads, or catching on to bramble bushes; considering the stony ways (rendered more stony for the occasion, I am sure) along which laden jam-jars must be carried; and, considering above all, the temptation ponds are for many children immediately on sight to fall into; well, then, pond dipping is surely best left to the older juniors. They, by their (proportionately) mature age, may be expected to exercise a *certain* amount of control over obstreperous nets and jam-jars, and to stand up more successfully to mother's scoldings on their bedraggled and probably belated return from a pond-dipping excursion.

But there are more educational reasons why this subject should not be taken too seriously by the young. The study of a community of plant or animal life, and the interdependence of one on another is so well illustrated in pond life that it has become the classic example. It should be studied with children of an age to understand it, and this viewpoint cannot be grasped before the age of ten or eleven. Up to this,

the children may well be paving the way for this study by watching the life-histories of frogs and toads and dragonflies, and may learn to recognize several other pond creatures put into tanks in the classroom.

Little children love activity. They love to watch movement, and the aquarium is a convenient means by which life and movement may be closely observed, especially in schools where nature rambles in the country are the rare treat. In the more fortunate schools in the country, however, there should be such a wealth of interest to be found in the woods and meadows as to make it quite unnecessary to introduce the pond community until near the end of the junior school years.

## POND DIPPING

As there is already a considerable amount of literature on the commoner pond creatures, written both for children and for students, this chapter will deal largely with the paraphernalia necessary for serious pond dipping, and with the setting up and care of aquaria, pointing out the biological reasons for as many of the activities as possible. If these are explained to the children *as they set up their own aquaria*, they will gain a much clearer view of the problems besetting animals and plants that occupy a watery habitat, and of the means by which they overcome the obstacles, than they would if the teacher did the work herself, or dictated each step to them without giving the reasons.

The following list of apparatus needed for a pond-dipping expedition may at first appear formidable, but may all be collected together without much difficulty. The children should make their own nets and jam-jar carriers, and should be asked to co-operate in collecting the other odds and ends. As the study of the pond community is to be a serious one it deserves time spent in preparation, and the latter half of the Spring term handwork class may well be given up to

the making of nets and jam-jar carriers, and possibly also haversacks.

POND-DIPPING APPARATUS

Net, at least one between two children.
Jam-jar in carrier, at least one between two.
Small stoppered bottles, such as aspirin bottles.
Two test tubes and a rubber band.
Fountain-pen filler.
Hand lens.
A teaspoon with the handle bent up at an angle of 45 degrees.
Large enamel bowl. A photographic developing dish is best, but a pie-dish is not to be despised.
A vasculum or flat tin box.

The large dish is used for tipping the contents of a net into, for examination, and the spoon with bent handle for catching small creatures and transferring them to jam-jars or bottles.

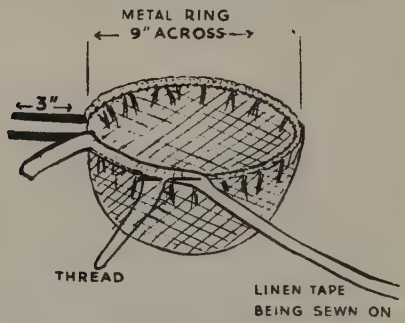
The stoppered bottles should have screw tops rather than corks. They will be used to carry small insect larvae. If a cork is rammed into a bottle almost full of water the pressure of air thus caused may kill the delicate larvae within. By putting a rubber band round the aspirin bottle a small phial may be held on each side while tiny creatures are taken from the larger bottle and put into the smaller by means of the pen-filler. Thus a certain amount of sorting may be done even by the pond side.[1]

Pond plants are best carried home in a vasculum or other flat tin. They should be packed lightly with as little bending as possible. Dragonfly larvae and newts will travel well amongst the weed.

A pond dipping net is not difficult to make provided you have a strong wire frame. This must be of galvanized wire that will not bend under the strain of a net full of weed and mud. Ask a blacksmith to make the ring to the measurements given

[1] For advice in compiling this list of apparatus I am indebted to Mr. A. S. Edwards, microscopist at the Haslemere Educational Museum.

in Fig. 11A. The extra three inches at each end are to fit into the bamboo handle. Strong linen muslin is needed for the net. Take a square of twenty inches and cut as large a circle as possible from it. Turn down a hem all round just wide enough to pass the wire frame through. Hem this down securely. File one end of the wire and push it into the hem until the net is in place on the ring. Now take one yard of linen tape one inch wide and sew this over the hem containing the ring with back-stitch, using strong thread. Allow three inches loose at each end as shown in the diagram.




A. Pond-Dipping Net. Half made


B. Braid cut in lengths and laid in position to be sewn together in centre


The Jam-jar Carrier completed

Fig. 11.

A bamboo stick at least half an inch in diameter and about four feet long forms the handle. Push the ends of the wire into one end, and ram in match sticks and plastic wood until it is quite firm. Glue the ends of the tape down the outside of the stick, and while still sticky, bind securely with string or twine. If this is damped first it will be tighter. Varnish the twine or string when dry.

An attractive jam-jar carrier may be made of coloured braid. For a two-pound jar three strips 14 inches long and one of 22 inches are required, and 8 inches of narrow elastic. Place the strips to form a star on the table, as in Fig. 11B and pin their centres together. Then sew them together securely. Sew the elastic into a circle and pin each end of the shorter pieces of braid to it at equal distances, except where the longer ones will come up. These are fixed seven inches up, leaving the remainder to form the handle. Sew the braid to the elastic and the ends of the long piece together and slip the jam jar into it so that the elastic comes round its neck.

## POND PLANTS

Early in the Summer term the first visit should be made to the pond. This is to study and collect the water-loving plants. As the welfare of the animals is dependent on the plants in an aquarium, these latter should be planted in the tanks about a week before the animals are put in. Evolution brought the plants before the animals and our model pond must grow likewise, albeit in a telescopic fashion as regards both time and space.

The chart "Pond Plants give to Pond Creatures," facing page 128, shows how animals depend on pond plants, and which plants are needed for particular animals, as well as for general purposes such as forming shade and shelter and aerating the water. (Plants give off oxygen during the process of photosynthesis and this is of immense importance in a pond

community where water, not air, is the medium in which all live.)

A further list of pond plants shows their relative positions in the water. This is not only useful to know when planting the aquarium, but it is also gives a more exhaustive list from which to select. Not more than one or two plants from each group will be needed, nor is it necessary to have representatives from both sections two and three, so long as there are some floating leaves to cast a shade.

1. *Plants floating totally submerged*

| | |
|---|---|
| Canadian pondweed | *Elodea canadensis.* |
| Hornwort | *Ceratophyllum demersum.* |
| Water milfoil | *Myriophyllum spicatum.* |

2. *Plants floating on surface, roots not anchored*

| | |
|---|---|
| Lesser duckweed | *Lemna minor.* |
| Greater duckweed | *Lemna polyrrhiza.* |
| Gibbons duckweed | *Lemna gibba.* |
| Ivy-leaved duckweed | *Lemna trisulca.* |
| Frogbit | *Hydrocharis Morsus-ranae.* |

3. *Leaves floating on surface, roots in mud*

| | |
|---|---|
| Water ranunculus (some leaves submerged) | *Ranunculus aquatica.* |
| Water lily | *Nymphaea alba and N. luteum.* |
| Broad potamogeton (and other potamogetons) | *Potamogeton natans.* |
| Water starwort (some leaves submerged) | *Callitriche aquatica.* |

4. *Stems and leaves rising out of water, roots in mud*

| | |
|---|---|
| Arrowhead | *Sagittaria sagittifolia.* |
| Burr-reed | *Sparganium ramosum.* |
| Great water plantain | *Alisma.* |
| Marsh speedwell | *Veronica scutellata.* |
| Yellow iris or flag | *Iris Pseudocorus.* |
| Reeds and rushes | |

5. *The Study of a Pond Community is a Serious One*

Note the photographic dish into which pond water containing a frog and other creatures has been poured

When studying these water plants, note that all submerged leaves are narrow, and either ribbon-like as in some of the potamogetons, or very much serrated, as in hornwort, water milfoil and water ranunculus. This allows free play of water around the plant and prevents a current from washing it away. Leaves resting on the surface present a broad blade, frequently round with the leaf stalk in the centre.

The presence of differently shaped leaves on the same plant, according to the position they hold, is most striking in the water ranunculus, but may also be observed in varying degrees in the potamogetons and water starwort.

## THE AQUARIUM

When collecting pond plants for the aquarium, care should be taken to get well-grown but young specimens, avoiding dead leaves and broken stems. Lay them carefully in the vasculum or tin, and on returning to school, float them in a bowl of clean water until required. Aquaria may be made in jam-jars, accumulator jars, enamel or china bowls or, of course, in a properly constructed aquarium bought specially for the purpose. A wide mouthed jar is always advisable as this exposes a greater surface of water to the air; and straight sides are preferable to round as they avoid distortion of the animals viewed through the glass and lessen the refraction of light in the aquarium.

A large, carefully stocked aquarium will last for months with little attention, provided the balance of plant and animal life is correct..

Everything that goes into the aquarium must be clean. The glass must first be dusted inside, and the sand washed again and again in a bucket. If a tank is being set up, plant any rooted plants in garden soil in tom-thumb flower-pots. Put these in the tank and carefully cover them with washed sand of a coarse nature, avoiding sea-shore sand because of the salt in it. A few stones, washed also, may be placed on the sand, some

being piled up to make little nooks and crannies in which the animals may hide. It is best, while putting in the sand and stones, to put newspaper all round the inside of the glass to prevent it from getting dirty.

There will not be room in a smaller aquarium for tom-thumb flower-pots, so the plants may be planted in the sand. Tie the plants, with cotton, to small stones, to keep them anchored when the water is let in. Lead bands ¼ inch wide and 2 inches long are useful also in anchoring plants. The band is bent round a clump of weed and hidden in the sand. This is an easy and effective method of anchoring the plants for it does not squeeze or cut the plants as cotton is apt to do. The lead bands may be used year after year.

There is quite an art in arranging plants and stones to make an attractive "picture pond"; and children will enjoy planning the best arrangement, not only from the æsthetic point of view but also to make the most comfortable home for the creatures that are destined to live there.

The plants lie limp until the water is let in, but they should be in the correct position, as, to move them afterwards, will stir up the sand and make the water cloudy. Plants floating on or below the surface of the water will, of course, be put in after the water. Room must be left for them, however, so do not plant too many of the rooted variety.

Tap water is best for the aquarium as it is clean. Some say pond water should be used as this contains micro-organisms on which the larger creatures live. But they are really best put into a clean water aquarium in the form of cultures. These will be described shortly. There are two satisfactory methods of pouring in the water so as to avoid disturbing the sand. One is to cover the sand, stones, and plants with a sheet of strong paper and to pour on to that. It is not always easy to lift the paper out when the tank is full, however, without disturbing the sand slightly. The other method (and it is the one I prefer) is to place a mug or other receptable in the middle of the aquarium

and pour into that. Soon it will overflow, but continue pouring into it all the time until the water has reached the required level. Water should be poured very slowly from a height in order that it may be well aerated (like rain on a pond). Whatever method of filling it is employed, the aquarium is likely to look slightly cloudy at first, and no animals should be put in it for some days, to allow the water to clear and the plants to grow.

It is advisable to set up several aquaria at the same time, even if one is a large tank. Jam-jar aquaria are useful for watching individual specimens and for isolating those that would devour their neighbours. Small enamel bowls may be used as temporary dwellings merely by putting in pond water (tolerably clean) and a little floating weed. These bowls and jam-jars may be carried to the other parts of the room for detailed drawings and observations to be made upon their inmates.

Aquaria need a special shelf or table and should not be exposed to much sun. As it is quite unnatural for the plants and animals to have light from the side at all, it is well to have a piece of brown paper, cut the correct size, to put round the jar or tank when not under observation.

A special visit to the pond will be made to collect animal life suitable to stock the aquarium. It is a mistake to attempt to keep too wide a variety or to think that a careful study can be made of everything that is found. Some creatures will be kept for long periods and others for short, and some may be examined at the pond and returned at once. Bringing home and housing the creatures presents similar difficulties to those of the man in the riddle who had to ferry across the river a goat, a lion, and a truss of hay. The dragonfly larva must not be kept with the tadpoles or it will bite off their tails, the stickleback must not live with caddis or it will bite off their heads; and the carnivorous water beetle must hardly meet anything else, for it is as fierce as a lion, proportionately.

Caddis larvae may, however, be kept with most of the other creatures, as their cases protect them, if they can withdraw

their heads quickly enough, which apparently they cannot for the swift movements of the stickleback! Pond snails are protected also by their shells and should be kept in all aquaria as they are excellent scavengers and help to keep the water clean.

In a large tank, carnivorous and vegetarian creatures may be kept together (with the exception of the carnivorous water beetle) provided sufficient food is supplied, and if one is prepared to indulge the ways of nature to the extent of "winking at" the disappearance of some of the smaller fry. There should always be a number of the insect larvae together so that one now and then will not be missed.

It is convenient to keep a culture of daphnia or other small water fry from which to feed the carnivorous creatures in the tanks. These may be induced to multiply by a simple but ingenious method discovered by H. J. Scomfield. Put a few rabbit droppings in a jar containing daphnia or cyclops. Pond water or water from a roof provides the best medium as it is not too pure. Scrapings of green slime from damp stones may be added, but moderation in all things is the rule in producing and maintaining a culture. Too rich a medium causes overcrowding and early death.

Raw meat should also be fed to the larger carnivorous water creatures. This should be dangled in the water on the end of a piece of cotton and should not be left for more than an hour or two as it soon makes the water bad. Ants' eggs may be scattered, in small numbers, on the surface of the water, but those remaining after a few days should be removed. Tadpoles are reputed to thrive on brown bread crumbs, but these again should not be left long in the water.

It is a good plan to cover all aquaria at night with muslin or a sheet of paper to keep the dust out, and those containing water beetles, pond skaters, water measurers, newts, water spiders and leeches need a permanent covering as those creatures are apt to crawl or fly away. The same applies to aquaria containing insect pupae expected to emerge.

Covered aquaria should have at least three inches of air space between the surface of the water and the covers, and newts will appreciate a cork raft on which to sit and muse.

The servicing of the aquarium involves the regular removal of any dead matter—dead leaves and stems, cast skins and dead animals, and the occasional replenishing of water and removal of dust from the surface. This is best done by drawing a piece of blotting paper over the surface. The vegetarians may deplete the plant life or bite through a stem and leave an otherwise rooted plant floating aimlessly. More plants may have to be installed from time to time. A long piece of glass tubing with a rubber bulb on one end is invaluable for sucking up anything that needs removal from the tank.

Two lists of carnivorous creatures are given below as a guide to their feeding. Some creatures are obviously more easily kept in an aquarium than others, but I am not going to say "don't keep this or that"; for experiment is the essence of scientific enquiry, and where one person will fail another may succeed in keeping any or all the creatures he finds. Be guided in your choice of aquarium dwellers by the studies you wish to make, not by the ease with which they are kept.

CARNIVOROUS POND CREATURES

| *Those requiring raw meat for food in lieu of other sizeable pond creatures* | *Those content with a diet of micro-organisms or ants' eggs* |
|---|---|
| Newt. | Newt larva (for first year at least). |
| Stickleback. | Pond skater. |
| Minnow. | Water measurer. |
| Dragonfly larvae (the larger ones; *Libellula, Cordulegaster, Aeschna*). | Dragonfly larvae (the smaller ones: *Calopterix* (*Demoiselle*) and *Agrion*). |
| Carnivorous water beetle. | Whirligig beetle and other small beetles. |
| Water boatman (*Notonecta*). | Alderfly larvae. |
| Water bug (*Corixa*). | Mayfly larvae. |
| Water scorpion. | Stonefly larvae. |
| Leech. | Phantom larvae. |
| (These creatures will also eat micro-organisms and ants' eggs.) | Water spider. |

### COLLECTIONS TO MAKE

Shells.
Empty Caddis cases.
Larval skins of Dragonflies, Mayflies, etc.

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CHAPTER VIII

# *The Quest for Flowers*

FLOWERS APPEAL TO SOME children much more than to others, and perhaps to girls more than boys. They are objects to be picked, to be arranged in colourful bunches, to decorate the room, to be grown in gardens; but for the most part junior children are not very inquisitive about flowers. This is my personal experience as well as that of many children I have taught. They find more to study in animal life, for the movement and diversity of form and mode of life appeals to them . . . and are we not animals ourselves?

But flowers, though perhaps not arousing so much curiosity, certainly appeal for their freshness and colour as well as for their names. Many names are quaint, fanciful, descriptive, even comical, and so utterly English that there should be no difficulty in learning a great many. And the more children can learn to recognize and name when young, the better equipped will they be for further botanical study when older.

Another reason why children should see and handle and become acquainted with a wide variety of flowers is that they may absorb such a love and reverence for our English country-side that they will, as a matter of instinct, treat it respectfully; refraining from rooting up plants, picking all they see, tearing branches from trees and bushes, or casting their litter amongst them. We want the children to grow up so sensitive to the beauty of the country-side that it literally hurts them to see it spoiled.

## IN THEIR SETTING

Suggestions were made in the first two chapters as to how very young children may have their attention drawn to flowers.

It is worth repeating here that children should, if possible, be put amongst the flowers to enjoy them as they grow, and that it is a very poor substitute to have the flowers brought to the classroom by the teacher for an indoor lesson. Compare the intensity of æsthetic enjoyment aroused in you when you are shown a bunch of alpine flowers brought home by a friend from the Alps, with that felt when you yourself actually find the flowers growing high on the mountain side.

It is the thrill of discovery that is so valuable here as well as the whole setting of the picture, and it runs all through the veins of the field-naturalist. He gets very little enjoyment (and the little he gets is spoilt by seeing a wild creature imprisoned) from looking at a golden eagle in the Zoo, but to find it in its highland home is a never-to-be-forgotten joy. Let us remember this in all our nature work with children. They need the thrill of discovery to lure them on and to open their minds; to feed the æsthetic sense and fill them with a fondness for the good things of the earth.

The kindergarten were quietly occupied at their tables under the shade of the great oak at the end of the lawn that was their playground. It was white with daisies. Presently the gardener appeared with the lawn mower. With one accord the children rose in righteous indignation and ran to him, begging, beseeching, demanding that their daisies should be left. They crowded round the machine so that it was impossible for him to move it and he had to retreat and find another job to do in the garden till the children had gone home.

### ON THE NATURE TABLE

Children should be encouraged to pick flowers in moderation and to care for them as living things. Every classroom should have flower decorations as well as flower specimens named on the nature table. An artistic pot should be supplied for the flower decorations and children encouraged to arrange

the flowers tastefully, to change the water every few days and to remove dead bits. Dead or drooping flowers are a sorry sight and offend the eye of the sensitive person, and we want the children to be sensitive on such matters.

Specimens on the nature table should be as carefully tended. A useful flower stand may be made to hold ten half-ounce bottles. Take a piece of wood 20 inches long by $1\frac{3}{4}$ inches wide by $1\frac{3}{4}$ inches deep. In this cut out ten circular holes with a brace and bit. The first should be one inch from the end and the others two inches apart (from centre to centre of the holes). The holes must be just wide enough to take the bottles and should go right through the wood from top to bottom. Make a base of a piece of thin wood (3-ply will do) $20\frac{1}{2}$ inches long by $2\frac{1}{4}$ inches wide, and nail this firmly to the wood block, leaving a $\frac{1}{4}$-inch margin all round.

A card index of flower names may be made alphabetically, the name of each flower being printed on a card $1\frac{3}{4}$ inches by $1\frac{1}{4}$ inches. This is a suitable size for use with the flower stand and may be made the standard for all labels. At the beginning of the season print labels for such flowers as may be expected to be found, and in an envelope keep a number of spare labels. The card index should be kept in a box of a suitable size and shape in a place where children have access to it. A similar index may also be made for trees.

## NAMES AND FAMILIES

It may be argued that there is little scientific value in learning English names for flowers. That may be so, particularly when one plant has several names (e.g. wild arum is also known as lords and ladies, cuckoo pint, wake robin, and dead man's fingers), or when the same name is applied to several plants, as in the case of the three *Erodiums* being called loosely, storks- or cranesbill.

No, English names, unsystematic though they are, *are* the

English heritage, and as such are simple to learn and important to cherish. It is amusing to make collections of flowers whose names have something in common. Take, for instance, those connected with man and his daily life:—

| | |
|---|---|
| Ploughman's spikenard | *Inula Conyza.* |
| Rest-harrow | *Ononis arvensis.* |
| Dyer's rocket | *Reseda luteola.* |
| Traveller's joy | *Clematis Vitalba.* |
| Shepherd's purse | *Capsella Bursa-pastoris.* |
| Shepherd's needle | *Scandix Pecten.* |
| Shepherd's weatherglass, scarlet pimpernel or poor man's weatherglass | *Anagallis arvensis.* |

Or names concerning cash:—

| | |
|---|---|
| Baldmoney | *Meum Athamanticum.* |
| Pennywort | *Cotyledon Umbilicus.* |
| Pennyroyal | *Mentha Pulegium.* |
| Pennycress | *Thlaspi alpestre.* |
| Moneywort | *Lysimachia Nummularia.* |

Or, best of all, those named after Our Lady:—

| | |
|---|---|
| Lady's slipper | *Lotus corniculatus.* |
| Lady's bedstraw | *Galium verum.* |
| Lady's mantle | *Alchemilla vulgaris.* |
| Lady's tresses | *Spiranthes autumnalis.* |
| Lady's fingers | *Anthyllis Vulneraria.* |
| Lady's smock | *Cardamine pratensis.* |

One could make lists of flowers named after birds: ragged robin, dove's foot, crowfoot, etc.; or after farm animals, or those whose names have been adopted as girl's names; but a glance down the index of any popular flora will supply a wealth of fascinating names.

But there are other more scientific methods of classification which may be used on any nature table in the junior school.

Flowers may be arranged according to habitat, or according to season.

A large notice proclaiming, "FLOWERS FOUND DURING FEBRUARY SHOULD BE PUT IN WATER HERE," will surely invite the children to make as large a collection as they can to brighten this often dreary month.

"Garden flowers and their country cousins" will make another interesting exhibition and will point the way to true classification by families. Such an exhibit would contain some of the following:—

| *Garden Flower* | *Wild Cousin* |
|---|---|
| Clematis | Traveller's joy. |
| Poppy | Field poppy. |
| Wallflower | Wallflower. |
| Pansy or viola | Heartsease. |
| Mignonette | Wild mignonette. |
| Lychnis | Ragged robin. |
| Hypericum | Any wild hypericum. |
| Sweet pea | Any vetch. |
| Rose | Any wild rose. |
| Snapdragon | Toadflax. |
| Michaelmas daisy | Sea aster. |
| Canterbury bell | Any wild campanula. |
| Polyanthus | Primrose or cowslip. |
| Anchusa | Vipers bugloss. |

In the above list both the garden and wild flowers chosen are out at the same season. It is only a representative list, of course, and may be added to almost indefinitely. It is chosen to show similarities and the effects of cultivation (i.e. larger flowers and brighter colours), but it should be noted that the garden flowers listed are not necessarily descended from the wild flower named opposite. They probably come from foreign stock of the same family. They are, in fact, wealthy cousins, not better fed brothers and sisters.

The classifying of flowers by various methods should lead

eventually to their classification by natural order. Until the children are quite familiar, however, with the parts of the flower and the diverse ways in which they may be arranged, *and* the scientific terms with which botany is beset, they cannot attempt to use a flora. Simplified floras compiled for the use of children are seldom satisfactory and are apt to lay stress on scientifically unimportant points, such as colour, which may be misleading. It would seem better for children to learn from their elders or from books well illustrated and with simple descriptive text, until they are old enough to use a flora. This probably puts the flora outside the scope of the junior school, except as an invaluable aid to the teacher.

But junior children are not too young to understand that flowers, like everything else in the world of nature, have been grouped according to similar characteristics, and are not a heterogeneous collection of lovely things. We cannot lay too much stress on classification as an aid to learning in all branches of nature, and modern naturalists owe a tremendous debt to those systematists of the last two centuries who did all this for us, giving us solid foundations on which to base our own investigations. It fills one with envy sometimes, to think of those early naturalists, and the scope they had for original work with the world of nature "so new and all," and as yet so unexplored. But that is a digression.

Collections may be made by children illustrating the characteristics of many of the common families, naming each after a popular member of that family.

Thus we have the

| | |
|---|---|
| Buttercup family | *Ranunculaceæ.* |
| Wallflower family | *Cruciferæ.* |
| Violet family | *Violaceæ.* |
| Pink family | *Caryophyllaceæ* |
| St. John's wort family | *Hypericineæ.* |
| Mallow family | *Malvaceæ.* |
| Geranium family | *Geraniaceæ.* |

| | |
|---|---|
| Sweet Pea family | *Papilionaceæ* or *Leguminoseæ*. |
| Rose family | *Rosaceæ*. |
| Willowherb family | *Onagraceæ*. |
| Sundew family | *Droseraceæ*. |
| Hedge parsley family | *Umbelliferæ*. |
| Daisy and dandelion family | *Compositæ*. |
| Heather family | *Ericaceæ*. |
| Primrose family | *Primulaceæ*. |
| Speedwell family | *Scrophularineæ*. |
| Deadnettle family | *Labiatæ*. |
| Dock family | *Polygonaceæ*. |
| Spurge family | *Euphorbiaceæ*. |
| Orchid family | *Orchidaceæ*. |

and others.

Some of the above families are large and varied in form, but at least those members obviously similar may be collected and learnt. Other families, such as mallow, St. John's wort, sundew, heather, violet and spurge, are small, and an effort should be made to collect all species of each family growing in the district.

The name "lip family" may be substituted for "deadnettle family" on account of the lip on each flower, giving the Latin name *Labiatæ*. Similarly, "umbel" or "umbrella family" may be used for the hedge parsley family. The likeness of these flowers to the wet weather article is obvious.

## STRUCTURE AND FUNCTION

Children should learn to count the number of petals on regular or nearly regular flowers, and to say whether they are free or joined, and by the age of eight or nine they should be ready to make simple diagramatic drawings, labelled with the following names of parts: sepals, petals, stamens, stigma, ovary or seed-box; and before they leave the junior school they should understand that the sepals are spoken of collectively as calyx, the petals as corolla; that the stem of the

stamen is the filament, and the "dust" pollen; that the stigma (unless sessile) is connected with the ovary by a tube called the "style," and that the ovary contains ovules in one or more chambers.

The children will learn much more than this concerning flowers, for the chief concern will be to learn what the flower *does*, and by flower it is meant now the whole flowering plant.

There are many excellent books dealing with the functions of the parts of the flowering plant, and it is probably the part of nature most familiar to the teacher, so it is unnecessary to repeat here what may be better expressed elsewhere. But may I remind teachers that a wealth of material may be used to illustrate botanical lessons, and that they should be adventurous in their choice of material and encourage the children to find as many examples of various points as opportunity allows.

Moreover, botanical lessons in the junior school should invariably arise from out-of-door observations, not vice versa.

The aim of the teacher should be, as it is pointed out in other chapters, to unify the observations made and draw out botanical lessons of lasting value from them. The children should go up from the junior school having absorbed, by a wealth of observations, a certain amount of botanical knowledge, and have it well taped in their minds and their notebooks by a few carefully chosen classroom lessons towards the end of their time. This botany will be, of course, inevitably linked with other biological aspects.

### POLLINATION

Choose large flowers and let the children scatter amongst them on a sunny day and *watch*. Flowers particularly suitable are: rhododendron, azalea, foxglove, sweet and garden pea, broad bean, lupin, larkspur and delphinium, nasturtium and pansy, broom and gorse, and wild rose, particularly field rose, which flowers abundantly and attracts many hive bees.

### SEED DISPERSAL

Visit plants that have been noticed in flower earlier in the year, and learn to recognize them in fruit too, notably woodland plants which flower in the Spring and fruit in the Summer: bluebell, primrose, wood anemone, wood sanicle, wood avens, stitchwort, violet, enchanter's nightshade. Listen to, and watch, gorse and broom seed-boxes popping on a hot, sunny day.

Examine the "merry-go-rounds" of cranesbill and the "boats" of the violet and pansy, and see how they treat their "passengers"—the seeds. Remember goatsbeard when illustrating "parachutes," and let children liberate the seeds of willowherb. Squeeze open the fruits of blackberry, elder, rowan, wortleberry and other soft fruits, and find their seeds. Find the "crochet hooks" of wood avens and burdock, and carry them on your clothes; shake the "poppy pepper pot"; collect the "dolls peas" on any vetch, and count the "pennies" in the shepherd's purse and honesty.

### GROWTH OF SEEDLINGS

Grow in flower-pots many trees from seeds and note the behaviour of the cotyledons. Find tree seedlings in the wood and make your own "forest." Note weed seedlings when gardening, and the appearance of all first leaves. Compare these with leaves of mature plants.

### FOOD STORES AND VEGETATIVE REPRODUCTION

Illustrate this by reference to woodland plants again, bluebell, celandine, pignut, wood anemone, wood sorrel, wild strawberry, etc., also by bracken and black bryony, as well as by those well-known examples quoted in botany books.

### COLLECTIONS TO MAKE

Dry seed boxes.
(Do not encourage pressed flower collections as these destroy life.)

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*6. Treated with Friendly Respect, the Woodman Proves a Fountain of Information*
Hoop-making in a Sussex wood

CHAPTER IX

# *The Quest for Trees*

FEW ASPECTS OF NATURE study have been more widely dealt with than trees. They deserve publicity and they certainly get it.

Trees are static, they are large, they grow in country and in town, they harbour bird and beast, they lend themselves to interesting study throughout the year. There are a number of kinds yet not so many that most, if not all, our native trees may not be easily learnt by the discerning student.

Trees may be recognized by their shape in Summer and Winter, by their bark, twigs, leaves, flowers, and fruit. There is scope for artistic talent as well as for accurate botanical drawing in the drawing of the parts. Their outline lends itself to woodcuts, their bark to rubbings (impressions made on paper with heelball similar to those made on brasses and inscriptions in churches). Collections may be made of fruits and seeds, of twigs and of leaves, for the pressing of leaves can do no harm to the trees and are effective and instructive.

There are indeed many activities that may be carried on with the purpose of learning to recognize the tree in all its parts. A word of warning is not perhaps out of place here. Do not let these activities become the main issue. Do not let them become an end in themselves. I have seen students become so excited over the making of impressions of leaves and twigs in plaster of paris that they rushed in and out of the house plucking any leaf that appealed to them quite regardless of method in their collection. The handwork had in this case supplanted the nature work. They did not know the names of the leaves they collected, and at the end they

had achieved casts of three or four ill-assorted, unnamed leaves, and *much* mess to clear up. And (this hurt me most), crumpled, broken little leaves lay scattered over desks and floor, bespattered with plaster and vaseline, and of no more concern to those who had plucked them, for they were obsessed with their own achièvement—*plaster of paris leaves.*

I am drawing a fine distinction here, I am aware, in advocating pressing leaves and disapproving plaster of paris or plasticine impressions, for both destroy the life in the leaf. It is the effect on the student or child that counts here, I think. In pressing, the leaf is itself preserved; but covering it with vaseline, pressing it into plaster, smearing lamp-black over it (I refer to yet another method of obtaining an impression), savour to me of cruelty, of wanton disregard for nature which in other ways we are so anxious to preserve. I know this is a sentimental attitude, but where other and better methods of learning to recognize leaves are available, why waste time on these particularly messy and complicated ones in which the danger of disregard is bound to creep in?

There is no better way of learning to recognize leaves and twigs than by drawing them. They are simple to draw and a collection of drawings is more lasting and more satisfying than any other collection.

Twigs may be collected in late Autumn, after the leaf-fall. They should be kept in water and their leaves will open out early in the Spring. Every week the water should be changed and the twigs rinsed in clean, cold water to wash off classroom dust and freshen the bud scales. Winter rains do this in plenty to the trees outside.

The shapes and colours of buds should be noticed as an aid to recognition, and descriptive labels be made for the twigs displayed on the nature table.

Thus we get the following:—

Ash: black buds.
Oak: little fat buds.

Beech: sharp pointed buds.
Lime: red buds.
Alder: mauve buds.
Sycamore: green buds.
Black Poplar: shiny brown buds.
Elder: naked buds.
Hornbeam: pale brown buds; twisted.
Horse Chestnut: sticky buds.

Charts may be made by the class together to show the recognition of trees by their several parts. A complete chart would have six columns headed, respectively, shape of tree, bark, twig, leaf, flower, fruit. To obtain drawings of all these would take almost a year's study, but it could, of course, be worked in with other activities, such as the discovery of birds and animals that make use of the trees for shelter and for food.

The tree chart may be simplified to suit the age of the class or the season during which it is made, if it is not desirable to continue it throughout the year.

Autumn is the time when trees push themselves most upon one's notice. Their fruits are falling and their leaves turning.

The trees are Indian Princes,
But soon they'll turn to ghosts.

Seeds may be collected and sown in moss (preferably bog-moss) to germinate. They should be kept damp but not too wet, and should be planted in flower-pots as soon as the root is about an inch long. Sieved leaf-mould mixed with a little sand is the best soil in which to grow them. Suitable seeds to grow in the classroom include acorn, horse and sweet chestnut, beech and sycamore. These germinate quickly and sustain the interest of the children throughout the Winter months. In Spring they will attract further attention by putting forth their first true leaves.

Ash takes two years to germinate; so do holly and other succulent fruits. They may be found in the woods as seedlings

and added to the seedling forest. Small trees may be kept in pots for years without growing too large. They remain dwarfed and do not flower, but otherwise carry on life much as a forest tree. Children will care for them devotedly.

It is more satisfactory, however, if space permits, to plant out the seedlings in their second year in a spare piece of land near the school, and watch them grow apace. Given freedom they will soon outgrow the children who planted them. A wooden label printed in indelible ink should be loosely attached to each tree. This should state the name of the tree, the date on which it was sown and the name of the child who found it. Old scholars revisiting the school will enjoy looking at their trees and remembering the days when both they and their trees were small together!

Obviously tree planting around the school cannot be undertaken very often, or the school will be shrouded in forest.

During October an Autumn festival may be arranged. Classrooms will be decorated with Autumn leaves and berries, and the nature table will display a show of the harvest of the birds and beasts. This will draw attention to the interdependence of nature, and particularly of the birds and animals on the trees. Attention will also be drawn to the different colours to which leaves turn: to the golden-yellow birch, the russet beech, the flaming-red cherry, and many more. Poems will be sought out and learnt for recital at the festival, for the poet has been kind to the tree.

This kind of thing does much to foster the love of beauty in the child. It is there all right and only needs a little drawing out, a little prompting in expression; and in this world of drab man-made mechanism we need to foster all the beauty we can.

Through encouraging a love of forest trees we are paving the way to a regard for the countryside as a whole. Are not the trees the clothing (the top coats and gay hats) of the

country? If we can discourage the mauling of limbs and the disfigurement of the bark of trees around villages and in parks we are doing a real work in helping to promote a more beautiful England.

I do not mean that we should be in any way sentimental over trees or any other form of wild nature. Far from it. Many forests are grown to be felled, and we must not mourn the loss of the trees provided the forests are either replanted or turned to agricultural use. Much may be learnt in the way of love of forests by visiting wood-cutters and fence-makers at work. There is also an opportunity for the practice of courtesy here. Children must learn regard for other folks' belongings and work. They must not crowd round the woodman so that he cannot, with safety, wield the axe or move the timber; they must not trample on his bill-hook or his dinner bag, or kick his clock hidden under a log. They must not sprawl over the newly shaved barrel-hoops, or knock down a stack of cord-wood. If they do any of these things they will get what they deserve—a surly request to get out. Treated with friendly respect the woodman will prove a fountain of information, both concerning his work and about the creatures of the wood: foxes, badgers, and deer. As he goes his lone way through the woods at dawn and dusk he sees much, for he is in tune with the spirit of the woods. Children should be encouraged to draw the woodman's tools and gadgets. They are simple in outline and effective in use, and most gadgets are made of the wood with which he is working.

In woods where sweet chestnut is grown there is much going on. The young timber is cut every six to ten years according to the purpose for which the wood is required. It is used for making walking sticks, fencing, pit-props for coal mines, and barrel hoops. The latter may be sent out to France where they are put round barrels of wine and sent back to the very same village in which the woodman lives

who cut them. Others may be used to strengthen orange-boxes, and *they* will travel even further.

Sweet chestnut is also cut for charcoal. This industry has been revived of late years and has been modernized by the use of enormous metal containers like gasometers, but the principle is the same as the good old-fashioned method which was carried on by our gardener and his brother when I was a child. Charcoal is simply wood that is charred right through but not reduced to ash. This is done by burning it with the minimum amount of draught. For this a cone-shaped fire was built about ten feet high. Long chestnut poles were stacked round the cone, inside of which was the kindling. Outside, the cone was covered with turf and earth, except for a small space through which it was lit. The fire took about a week to burn, during which the charcoal burner lived in a log hut of his own construction and tended it carefully, blocking up with fresh turf any weak spot through which smoke or flame belched out. His wife brought him his food each day, and it was one of my childhood joys to go with her and carry the basket neatly covered with a white napkin, and to hear her old man proclaim himself "hungry enough to eat a donkey!" I would peer into his dear little hut and see his four-poster—yes, it was—four chestnut posts driven into the ground with a piece of wire-netting stretched across!

In many woods now there remain flat, circular patches of blackened earth telling where the charcoal burner has been at work. Charcoal is still burned in this way in Spain, cork oak being the wood used where I have watched it.

The felling of big timber is a most exciting business, and the teacher who takes her class to watch it must do so realizing the dangers and determined to keep the children out of reach of the tree in all directions. Woodmen can and do control the direction in which the tree falls, but accidents may happen and one cannot be too careful when a mere onlooker.

Before cutting the tree, the woodman examines it to see on which side the boughs are heaviest. That is the side the tree would most naturally fall. If it is not convenient for it to fall that way (if, for instance, it will crash against another tree and get "hung up") he may rope it to other trees to prevent it going the way it wants. He may even get a tractor to pull, from a distance, on a rope or chain attached to it. But if the direction is to be changed only slightly from its natural course, probably the preliminary cut with the help of wedges will do the trick. Before sawing through the trunk, the woodman makes a deep wedge-shaped cut with the axe on the side to which the tree is to fall. Then he and his mate saw through from the other side, a little above the preliminary cut, with a double-handed saw. As they get near the middle, the weight of the tree is apt to make the saw jam, and iron wedges are driven in with an iron mallet to ease the strain. In order to help the tree to fall the right way, the wedges may be knocked in to tilt the trunk accordingly. A little more sawing, and then there is an ominous creak. The men look up. They go on a minute or so more, and then, as the tree totters to its doom they get up from their knees and move out of the way. It is all done deliberately and in a quite unhurried way, as only skilled workmen dare.

When the felling is in process there is much burning of woodland rubbish. The twiggy bits, known as frith, must be burnt out of the way, and what a delight it will be if the children are allowed to help.

"What lesson *ought* we to be doing?" asked Jan as she flung a branch on the blazing pile. The class had been released from geography (that could be done at any time, this bonfire only now), and what a release it was! Keeping near the fire to see that no one inadvertently flung himself on it, I gained a real insight into the "best nature" of these children. That urge to test his strength. The pushing and pulling and tugging at long, sprawling branches; the call for help and

the eager co-operation as two or three pulled together. There was real perseverance here, scorn for tumbles, scratches, and smoke in the eyes. All were set on one purpose, the building of an enormous bonfire. There was a spontaneous cheer as the flames broke through and blazed up into the tops of the trees, and the entirely happy camaradie that pervaded all that afternoon was quite magical. It was the magic of the woods.

Autumn picnics in the woods around a camp-fire constructed by the children will do much to stir in them a love of the good things of the forest. The picnic should have an object. It may culminate a nature ramble, or a wood-gathering effort, or an afternoon spent picking blackberries or rose-hips. Emphasis should be laid on the correct woodcraft way of doing things and the fire should be properly built of dead wood only.

If paper is not to be permitted in the laying of the fire (and it is not used in the best fire-lighting circles) birch bark, holly leaves or dead bracken may be used. Dead leaves are not a substitute for paper as they only smoulder. So does bracken if used too thickly. The tiniest of thin twigs from the trees (not those lying on the ground, which are apt to be damp), should be built up round the birch-bark and fern, and around this, cone-fashion, some coarser kindling. Do not make the fire too big to start with but have a pile of wood nearby from which to draw as required.

Test for the direction of the wind before lighting. This may be done by holding up a handkerchief or a wet finger. The handkerchief will blow the way of the wind, and the finger feel cold on the side from which the wind is coming. Then get down close to the fire with your back to the wind, light the match in the cup of your hand close to the birch-bark, and light as much bark and fern as possible with the one match.

Woodcraft develops character and observation in children.

They learn to use the good things of the earth and at the same time to respect the amenities. Great stress should be laid on leaving the site of the picnic tidy. There should not be a scrap of paper to be seen, and the fire should be put out and covered with earth.

Hut-building and tree-climbing should be encouraged and may well be linked with tales of primitive man. Given a wood in which to play, children may live through primitive times, constructing their tree-platform, digging out a pit-dwelling, mounting stones in wooden hafts for implements, and making clay pots from local clay to bake in their own open fires. Their efforts will not be so skilled as those of the genuine primitive man, whose muscular strength was infinitely greater, but that is of no consequence. It is the activity which is of value, and the imagination behind it—and, above all, the growing love of the woods.

### COLLECTIONS TO MAKE

Fruits and seeds of trees.
Pressed leaves.
Tree seedlings to grow in pots.

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CHAPTER X

# *The Quest for Fungi and other Non-flowering Plants*

To Kindergarten News one day a little boy brought presents for everyone—puff balls. There was exactly one each including the teacher, and they all sat round in a circle happily puffing their balls.

The study of fungi and other non-flowering plants is generally considered too technical for young children, but as children are so often attracted by these lowly members of the plant world, some explanation of them seems necessary.

It makes an attractive Autumn and Winter study, and much interest may be derived from it, provided the study is kept elementary. Moreover, it should provide the children with a working knowledge on which a more detailed study may be based later on.

## FUNGI: STRUCTURE AND FUNCTION

The subject of fungi arises naturally every Autumn when the oak and beech woods become splendid hunting grounds for many kinds. As soon as the need arises (i.e. when the children begin to notice the toadstools and bring them in to be named) take the opportunity of comparing the toadstool with the flower. This serves to revise work done in the Summer when flowers were "all the rage." Recall the bright colours of the flowers and their many parts, and the elaborate devices to ensure pollination. This leads on to seeds and their vital purpose—that of perpetuating the species. From this pass to the seeds of the toadstool, which are not the result of flowers

as we know them, but are produced in a different way about which the children can learn more when they are older.

These "seeds" however, can be seen in quantities when the stem is cut off from a "gill cap" toadstool (an agaric) and the cap is placed gills downwards on a contrasting piece of paper, black if the gills are white, and vice versa. Cover it with a jar or tumbler to keep draughts away, as these would blow the "dust" and spoil the pattern we hope to see next day.

Although the "dust" is not composed of seeds as these are known in flowers, it does the same work. The tiny grains of dust may be called "spores." Children soon learn a few new names if they are not too difficult, and it is as well they start with the correct name whenever possible.

Next make a very elementary study of the whole plant, choosing honey agaric (*Armillaria mellea*) if possible, on account of its coarse and prolific growth and thick mycelium. Mycelium is a word the children must learn to use instead of root, as the mycelium is the PLANT, doing the work of roots, stems, and leaves, i.e. getting and distributing food to the spore-bearing toadstool.

Having gained an elementary idea of the structure of the honey agaric, pass on to the influence that this particular toadstool has on other forms of life. Honey agaric attacks trees. The spores lodge in little cracks and hollows and the mycelium threads its way between the bark and wood of the tree trunk, sapping the tree and weakening it. The bark becomes loose and tends to tear away. This is increased by wind, rain, and snow, and insects and other "creepy-crawlies" get in. Eggs are laid and these hatch into wood-boring grubs which have a fine time in the slowly rotting wood. But not for long! The woodpecker discovers them and pecks rough holes in the wood, digging them out with his strong beak, and returning again and again for more.

In Spring, perhaps, a nesting hole is bored into the very heart of the unfortunate tree. Other fungi get in, notably

"brackets" of various kinds, and continue the destruction. On birch trees, the birch bracket (*Polyporus betulinus*) grows very large, taking on the colour of the bark, and sometimes forming a delightful porch over a woodpecker's front door, to the delight of the children who find it, but ending in the death of the tree. But it was all due to the honey agaric in the beginning! This toadstool then, likes rotting wood, so do others; while more still prefer dead leaves. The work of toadstools is essentially destructive, but this is not always a bad thing, for they often act as scavengers and remove dead material. In the breaking down of layers of dead leaves into leaf-mould, the toadstool is playing a very useful part, as we see when we collect leaf-mould for our gardens, or for growing bulbs indoors. (Some teachers may say this is getting too difficult for the seven-year-old child to grasp. Perhaps it is a little. But if touched upon lightly, out in the woods with the actual dead trees, leaf-mould and mycelium to examine, it is not, for we have done it and enjoyed it. Do not expect the children to answer an examination question on it!)

### CLASSIFICATION OF FUNGI

Running concurrently with this attempt at "structure and function" should go a simple sort of classification. The children are always asking "What is this?" and in order to remember a number of names, some kind of classification is necessary. However much this may be simplified, it must be correct, or the children will have to unlearn it later on. Start the classification by dividing the specimens found into two groups according to their appearance:—

(*a*) Toadstools (those with cap and stem).
(*b*) Other fungi (those with any other forms).

### A. TOADSTOOLS

These may be divided into three families according to the arrangement of the spores under the cap: gill caps (*Agaric-*

*aceæ*), sponge caps (*Polyporaceæ*), and spine caps (*Hydnaceæ*).

Very often specimens of the first two families only are found but it is well to describe the characteristics of the third in order to encourage the children to look carefully for it. For most young children, these names are sufficient, but there are several particularly striking toadstools for which individual names may well be given for the benefit of those who find names easy and pleasant to learn. Moreover, some names are obvious, and others fascinating, so here they are:—

Among the gillcaps, one gets, first of all, three very poisonous toadstools which children should be warned not to pick. Fly agaric (*Amanita muscaria*), is the lovely red toadstool with white flakes on its cap, and a white frill round its stem. Death cup or destroying angel (*Amanita phalloides*), is probably the most poisonous British fungus, and a careful description of it is desirable so that it may be readily distinguished from the mushroom. It has on many occasions been confused with the edible mushroom with fatal results, though it is only in the "button" stage that there is any real resemblance. It grows beneath trees and it is therefore wise to make a rule never to gather mushrooms from under trees or hedges, or even haystacks. The death cup is slightly sticky when moist but not really glutinous, and is of a dirty greenish yellow or olive colour. The gills and stem are WHITE, as also is the conspicuous ring round the stem. The stem is thick and solid at the base, tapering slightly as it grows up. *Amanita mappa* has no English name, but I suggest yellow napkin as a suitable one for children to use. Mappa means napkin and refers to the torn volva at the base of the stem. This resembles a table napkin folded fancy-wise as is the custom at dinner parties.

The yellow napkin is whitish yellow with irregular scales on the cap. The gills are white. It is a common and handsome species, found in the woods in Autumn, particularly under beech trees, where it should be left severely alone.

Other gill caps it is safe for children to collect, although

they should be warned not to taste any without an adult's permission. Here are some more of the commoner and more noticeable species:—

Mushroom (*Agaricus campestris*). It is very important to be able to recognize this without a doubt on account of its edible qualities. The cap is creamy white, dry, and silky. The gills are pink, turning gradually to brown as the mushroom ages. The flesh (when the mushroom is broken) is white, tinged with pink. There is a ring round the stem, the remains of a flaky skin growing from the cap to stem when very young (in the "button" stage.) Mushrooms for food should be gathered from open fields or downs only, not from under hedges, trees, or haystacks.

Chanterelle. (*Cantharellus cibarius*). The cap and stem are the colour of yolk of egg. The cap is irregular and wavy at the edge and the gills broad and running down the stem, which latter is thicker at the top than the base. It grows in scattered groups in the woods, particularly under beech trees. It is edible and in Switzerland is commonly gathered and dried for winter consumption.

Red russule or sickener. (*Russula emetica*). This is an attractive rosy pink toadstool with white gills and stem. It is poisonous and quickly produces sickness if eaten. Slugs, however, appear to thrive on it, for it is difficult to find a specimen that has not been attacked either in the stem or on the cap by these creatures. It grows commonly in deciduous woods, favouring the rich leaf mould beneath beeches.

Milk toadstools (*Lactarius*) give out milky juice when broken. There are several species, but children will probably be satisfied to call them by their generic name.

Ink caps (*Coprinus*) comprise also a genus. They grow on very rich soil and turn to an inky black fluid as they rot.

Parasol mushroom (*Lepiota procera*) is like a large brown fly agaric, sometimes standing eight inches high and measuring nine inches across the cap. It is a delight to small children and

is quite harmless for them to pick, being considered a tasty esculent. It has numerous pale brown scales on the cap, and a large flabby ring round the stem which becomes loose and movable. It grows in meadows and forms large "fairy rings."

The genus hygrophorus includes the lovely shiny little scarlet-hood (*Hygrophorus coccineus*) which grows abundantly in mossy meadows; also the yellow and green one known as parroquet or the parrot toadstool. Both these and other members of this genus attract water to the surface of the cap, making it constantly wet and shiny.

One of the genera in the family *Polyporaceæ* in which the species have cap and stem and are therefore toadstools is boletus. Some of these are harmless, some very poisonous, so that children should be warned to be careful to wash hands, etc., after handling them, as indeed they should after dealing with any fungi. The shiny yellow boletus (*Boletus luteus*) is perhaps the most easy to recognize on account of its very glutinous brown cap and yellow spongy under-surface. It is common under pine and larch trees in Autumn.

Lurid boletus (*Boletus luridus*) is very common in deciduous woods, and very poisonous. The top of the cap is "matt," to use a photographic term, almost downy, and varying in shade from yellowish to dingy brown. The sponge is yellow, and the yellow flesh when exposed to the air, turns indigo blue.

Edible boletus (*Boletus edulis*) is perhaps the largest and coarsest of this genus. The cap is pale yellowish brown and the sponge and flesh white. It is also common in woods in Autumn.

Of the spine caps, two species may be found, though neither is particularly common.

Wood urchin (*Hydnum repandum*) is the larger. It grows in damp deciduous woods, and is cream coloured and irregularly shaped; the stem is rather to one side of the cap, the spines travelling down the stem.

*Hydnum auriscalpium* may be looked for on fallen pine cones. It is not more than a quarter of an inch across the cap and is a dark brown colour like its background.

### B. OTHER FUNGI

Of these one may come across six different groups during the Autumn and Winter rambles. I will content myself by outlining the extent to which each group may be studied with children.

1. Brackets. This term is perhaps rather arbitrary, but it denotes any fungus growing out of a tree trunk or branch in the form of a bracket. Many of these are polypores, but a few are agarics. In all of them the spores are on the under side of the bracket (thus protected from rain) either in gills or spongy tubes. Many are dry and woody and may be kept for years.

A very simple method of naming these is by the tree on which each grows, e.g. birch bracket, oak bracket, etc. This also helps the children to recognize the trees by their bark. But one soon finds more than one species on the same tree, or the same species growing on several trees, and then more accurate naming becomes necessary. Here are a few of the common kinds:—

Dryad's saddle (*Polyporus squamosus*) is found chiefly on elm and ash and grows to an enormous size in a short time. It is pale yellow above, rather scaly, and the underside is cream coloured.

Fir-root polypore (*Fomes annosus*) is a common and dangerous parasite on pine. It is brown above, and white beneath, but very variable, and in some cases forms a scab on exposed roots or encrusts stems and even leaves.

Common stump flap (*Polystictus versicolor*) is a small, thin, leathery bracket growing in clusters on stumps. The upper surface is beautifully velvety, zoned with grey, black and mauve in various shades.

Oyster bracket (*Pleurotus ostreatus*) is found on several trees and may be known by its broad white gills which join in a point where

7. *Woodcraft Develops Character and Observation*

A class measuring timber. One child is counting rings to tell the age of the tree while others note its length and girth. Note the tape-measure

the bracket protrudes from the tree trunk. Sometimes there is a stem, in which case the gills travel down it, converging to the base. This belongs to the *Agricaceæ* family and takes it name from the colour of the bracket.

I have already mentioned the birch bracket, the name generally given to the *Polyporus* found on birches. There is another, however, an agaric (*Lenzites betulina*) for which there appears to be no English name, but I would suggest "birch agaric" for children. It may be readily distinguished from the former by the presence of broad, white gills.

2. Jellies. (*Family Tremellinaceæ*)

These are just a wee bit repellent perhaps, with their soft clammy feel and uncanny way of appearing and disappearing in the night! There is a golden yellow one on gorse and hazel, known as witches' butter (*Tremella mesenterica*) and a velvety brown one known as Jew's ear fungus (*Hirneola auricula-judæ*) which has a striking resemblance to the human ear. This is found on elder and elm trees. The spores form a bloom on the inner surface.

3. Clubs or Clavarias (*Clavaria family*)

There are several common species generally found in grass. They are small and club-shaped, and grow in clusters. Some are branched like the antlers of a stag or like coral. We have contented ourselves by naming them by their colours, white clavaria, yellow clavaria and red clavaria.

All the fungi so far described belong to the sub-order *Basidiomycetes*, the characteristic of which being that the basidia (the spore bearing structures) are exposed. The next group—puffballs—belong to the sub-order *Gasteromycetes* (in the same order) the characteristic being the ball enclosing the basidia. (Gastro—a stomach.)

4. Puffballs.

True puffballs may be distinguished from earthballs (of the same group) by noticing that in the puffball the spores escape from one hole at the top, while in the earthball (*Scleroderma aurantium*) the casing cracks irregularly over the upper surface to release the spores. Earthstars (*Geaster*) also of the puffball group, are uncommon, but if one is found it may be kept for years and enjoyed afresh each season. The joy of an earthstar is its delightful shape, caused by the outer envelope splitting into four "petals" and curling backwards to form a stand on which the little ball opens like a tiny Vesuvius and smokes away bravely for years!

Bird's nest fungus (*Crucibulum vulgare*) is another popular member of this group. It grows on rotting wood (e.g. garden-frames and seed-boxes) doing its best to make the wood crumble away altogether. Starting as a tiny biscuit-coloured puffball, it soon opens into a cup-shaped nest, containing about half-a-dozen "eggs." These are clusters of spores joined to the base of the nest by means of spiral cords. When the spores are ripe, the spiral shoots out, depositing the "egg" some inches from the nest. From here the spores scatter and form new plants.

One more member of this fascinating group is the stinkhorn (*Phallus impudicus*). This differs from the other gasteromysetes in being particularly soft and messy, whereas the others are dry and papery and last for years. Its relation to the puffball family is obvious when the stinkhorn "eggs" are found just below the surface of the ground. These are round and soft and white, not unlike snakes' eggs, and joined together by white threads—the mycelium. When the spores ripen, the "egg" bursts open and the spore-bearing cone rises rapidly (within a few hours) on a spongy stem some four inches high. It is sticky and messy and smells of rotten eggs, but is calculated to attract flies for whose taste there is no accounting! The flies crawl over the cone sucking its juices,

and fly away with spores attached to their bodies and legs—a clear and unusual example of dispersal by insects amongst the fungi. There is a smaller and less common stinkhorn, the dog stinkhorn (*Mutinus caninus*) which has a long slender stem and an orange cone.

5. And now we pass to a different order, the *Ascomycetes* in which are some quaint specimens. The peziza family contains three common species, whose names are particularly attractive: orange peel, elf cup and batchelors buttons. Orange peel (*Peziza aurantia*) grows along the margins of newly-made roads and on bare patches of heathland. It is like pieces of orange peel thrown untidily away. If put in a saucer and kept damp it gives off clouds of yellow spores in the sunshine. These come from the upper, or inner surface, the characteristic position of the spores in all members of the family.

The charming elf cup (*Peziza coccinea*) is found on dead wood, generally in limestone districts, and is a joy to any child's heart! It is bright crimson red, very round and neat, and is generally seen peeping out from a carpet of green moss.

Batchelor's buttons (*Bulgaria polymorpha*) is thicker in growth than the two previous pezizas; is round and black, rather like a licorice sweet, and grows freely on newly-felled oak trees.

The vegetable caterpillar (*Cordiceps militaris*) is club-shaped, about an inch high, of an orange-red colour and granular in texture. If carefully dug from the ground it will always be found attached to the mouldy skin of a dead caterpillar on which it grows.

Neither the vegetable caterpillar, nor candlesnuff (*Xylaria hypoxylon*) should be confused with the clavarias described earlier in this chapter under the order *Basidiomycete*. Candlesnuff is frequently found growing in clumps on stumps and dead wood. It is leathery (whereas all clavarias are soft and brittle) and is black with a white bloom on the upper parts

like the wick of a snuffed candle. Sometimes it is branched, when it resembles reindeer's antlers in velvet. The white bloom is not the spores, however, for they cover the velvety black part below.

### OTHER NON-FLOWERING PLANTS

There are some subjects which may be legitimately simplified for young minds to assimilate; there are others which loose their fundamental truth when watered down. Much of the study of ferns, mosses, liverworts, and lichens comes in the latter category. Taken by and large it is better left for the seniors to tackle their long names and structural detail, and also the microscopes that will be needed for their examination.

It is, however, one of the onerous duties of the teacher to answer truthfully, if scantily, the many questions asked on a ramble, and the "What is this?" pointed at one of these lowly members of (plant) society is inevitable sooner or later.

"And what is a liverwort? Is it a moss or what?" further enquired an eager eight-year-old after I had hoped to have settled the matter with one brief answer. The obvious reply, "No, a liverwort is not a moss, but a liverwort," sounded very lame, and I felt the need for further knowledge myself as I sought to elucidate the matter, and felt myself sinking deep in a morass of wordiness.

The main structure and development of the various groups of non-flowering plants is clearly given in most senior biology books and every teacher of nature study should make herself acquainted with them, though very little will she be able to pass on to junior school children.

It may be a help in answering their questions to have the evolutionary order of plants clear in one's mind, and an intelligent group of juniors will grasp the idea too.

Taking flowering plants (including grasses) as highest and most complex, the non-flowering plants fall in behind thus

(in descending order): ferns, mosses, liverworts, lichens, fungi.

Beyond the fact that a lichen is a combination of a fungus and an alga living in symbiosis, there is nothing more complex in its structure than in that of a fungus. Neither produces *chlorophyll*, and they should, perhaps, be bracketed bottom of the class.

If children can grasp, after examination of many living specimens, the fact that these five groups of plants become less and less like flowering plants the lower they come in the scale of life, they have made a beginning.

Ferns are obviously something like flowering plants in bearing large leaf-like structures with mid-ribs and blades in varying degrees of serration. Mosses are smaller than most flowering plants, but still have some resemblance to green leaves. Liverwort "leaves" are less like true leaves (in the larger species at any rate) in being attached to the ground at intervals. Lichens and fungi have nothing resembling leaves, though a certain group of lichens is termed "foliose."

The leaf-like structures (called "fronds" in ferns) do the work of leaves, but in many cases also bear the fruiting organ. This may be clearly seen at the back of a frond. Each brown "pimple" is called a *sori*, and contains a great number of spores like brown dust. Only certain fronds bear *sori*, others being barren though otherwise similar in structure. The spores of most ferns ripen in Summer and a walk through a patch of bracken in August or September may raise a cloud of brown dust which covers one's shoes and clothing with a mass of spores.

The spores of mosses and liverworts are borne in structures known as sporangia. In some cases they rise on their own stalks, in others they are tucked in a fold of the leafy structure. Children may find some of the more obvious sporangia, particularly the "head and neck" of the swan's neck thread moss (*Mnium hornum*) and the delicate "green apples" of the apple moss (*Bartramia pomiformis*). Late Winter and early

Spring is the best time for the study of mosses, as many of them are in fruit.

The sporangia of the larger liverworts (members of the sub-order *Marchantia*) that grow freely on banks of streams and damp walls, may be found from February to April or May. They grow on long thread-like stems of a semi-transparent, colourless appearance, and at first the capsule is round, black, and shiny. As the spores ripen, this bursts open and is brown and furry (the spores). In some species the capsule opens into a star-shaped "flower" and in others into a delicate little "umbrella."

Lichens may be found growing on the bark of trees, on stones and on the earth. They have the honour of being the first colonizers of the earth. It is lichens which pave the way, prepare the ground, for the other plants. Their needs are so simple that they can get along quite happily on a sun-baked rock. Their action being somewhat acid, they break down the surface of the rock extremely slightly, and this mineral dust mixed with dead lichens forms tiny pockets of soil in cracks and fissures. Mosses are generally the next plants to find a foothold in these fissures, and *their* decaying bodies, being larger and more complex in organic matter, provide more and better soil for higher forms of plant life.

Lichens require a high degree of purity in the atmosphere, and woods and trees in and around cities will be found barren of them. They also show a decided preference for the south-west side of a tree, and this may prove an aid in finding one's bearings in the country.

There are some fascinating forms of lichens, most fascinating being the cup lichen (*Cladonia pyxidata*) and the sealing-wax lichen (*Cladonia coccifera*), both found growing on sandy soil or rotting stumps. Cup lichen frequently grows tiny goblets from the rim of the main goblet. It takes little imagination to picture these dainty little claydonias in daily (or perhaps nightly) use by the pixies.

Lichens are frequently used for dyeing, and in Scotland school children do much of the collecting of them for this purpose. The dyes used in Harris tweeds come mostly from lichens. They give many shades of reddish and golden brown, according to the species used and the length of time they are boiled with the wool. Lichens growing on rocks give a stronger colour than those on wood, and those growing on rocks near the sea give the strongest colour. They need no mordants, for the colour yielded up when boiled, passes readily into the wool and remains fixed there and does not wash out. They are very satisfactory for experimental dyeing in school for they are easy to get and simple and effective to use. Dyers generally use the word crottle (or crotal) when referring to lichens.

### COLLECTIONS TO MAKE

Dry, woody or papery fungi such as puff balls, earthstars, birds-nest fungus, candlesnuff, and certain brackets.

Samples of wool dyed with different lichens and other plants, such as gorse flowers (yellow), onion skins (yellow), madder roots (red), dog's mercury (dull green), young bracken leaves (cream), heather (yellow).

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CHAPTER XI

# *The Ecological Approach*

IN CHAPTER III a brief reference was made to the study of ecology. What is ecology, and in what way does it differ from other forms of nature study?

Just as social economics deals with the life of a community of human beings, and the problems arising out of their inter-relations, so ecology is the study of plant and animal communities and the problems arising from their close proximity. As social economics cannot be studied without constant first-hand experience of the conditions within the community, so ecology can only be studied by intimate field study. It is essentially a first-hand study of a particular piece of countryside. This means getting out with note-book and pencil, trowel and collecting-tin, and working on the spot. Surely all that has been said in the previous chapters points direct at this—just getting out and learning from nature.

It is perfectly possible in other forms of nature study for the teacher to collect specimens, dole them out one per child in the classroom and discourse upon them. But ecology cannot be done that way, for the plants must be studied in relation to each other, to the animal life, and to external conditions under which they live.

Ecology is, therefore, a specialized form of the nature study of one's environment. The nature rambles from the kindergarten up have been paving the way for this and it makes a most fitting finale to junior school nature study that the children in the higher forms should undertake the study of a piece of land, and all that is thereon. It consolidates knowledge gained incidentally in the earlier years, and it opens the mind

to such problems as *lebensraum*, survival of the fittest, and evolution.

There may be said to be two aims in the teaching of nature study by ecological methods. Firstly, to gain an understanding of the vegetation and animal life of one's own region, and through this to an understanding of other natural regions. This gives an attitude of mind capable of enjoying natural scenery to the full, and foreign travel becomes something more than a holiday. This aim may be called the extensive aim. Secondly, one should aim at obtaining a basis on which to build detailed studies of specific plants and animals or certain aspects of their lives. This may be called the intensive aim. The following of this two-fold aim should, surely, produce the alert and enquiring mind.

## ECOLOGICAL SURVEY METHODS

Supposing one were to set out to discover all one could about the nature of a hitherto unexplored island (I can imagine few more fascinating occupations!). A knowledge of ecological method would be essential if the work were to be done thoroughly.

One would first explore the land to discover its chief features. This excursion might be called the reconnaisance. One would scale the hills and view the land; map it as best one could, marking the chief units of vegetation—the forests, grasslands, swamps, heaths, etc. One would collect samples of soil from the various units and examine them at home. One would note the chief plants in each region, collecting and pressing any that were unfamiliar.

The reconnaisance done, one would next cover the land more slowly and fully on a second visit, carrying out what is known as a primary survey. For this a carefully drawn map, scale not less than six inches to the mile, would be desirable. A compass, trowel, tape-measure, marking sticks, and mallet,

test tubes for further examples of soil, a collecting tin, pocket lens, field-glasses, penknife, note-book and pencil would also be needed.

On the primary survey ramble, one visits and examines each plant association: the heath, wood, swamp, etc.

In each of these a list of the plants is made, in order of their frequency. This will not be an exhaustive list, but will show the plants that are characteristic of the association. The chief or "dominant" plant was noted on the reconnaisance. Now it will be checked by closer examination, the sub-dominant plant or plants noted, and the others marked as being either frequent, occasional or rare.

In many associations there will be plant life growing in two or more strata. In each of these layers the plants should be listed as being dominant, sub-dominant, frequent, occasional or rare. Thus in a forest there is the tree layer, shrub layer, herb layer and moss layer. On the heath there are probably two—the herb and the moss, while in the meadow there may be only a herb layer.

Many factors influence plant growth and the life of the plant community. Some of these will be discovered on the primary survey. These factors may be classified under four headings: physiographic, climatic, edaphic, and biotic.

Physiographic conditions of a habitat colonized by a certain plant community include height above sea-level, aspect and slope. Climatic conditions comprise rainfall, wind, light and temperature. Edaphic factors concern the soil and the geological foundations. Biotic factors are those of the influence, adverse or beneficial, of all animal life, both wild and domestic as well as that of man. Thus one needs to consider the influence of such things as insect pests, animals grazing and gnawing bark, birds dispersing seeds, draining, burning, and felling. Many of these will not come into consideration unless man has been at work, as he almost certainly has not on a hitherto unexplored island!

It will be seen that the execution of a primary survey over an island of varied vegetation is a big task. Moreover it is well to add yet one more occupation to this part of the work, that of laying down quadrats for further detailed study.

It is not practical at this stage, to list every plant growing in each habitat, but a complete list for a small, carefully selected, typical area is useful, especially in marking down seasonal changes and in noting the changes from year to year. There are several methods of making these detailed studies, but perhaps the most usual is the quadrat. Though it is well to mark its position when making the primary survey, the study of it may be left for another day.

A quadrat is a square of any convenient size for mapping each individual plant and its relation to its neighbours. In a wood a square yard or square metre is a useful size; in grassland where the vegetation is very thick a square foot is probably sufficient. The tape-measure, marking sticks, and mallet are used here. The square is marked on the ground and the marking sticks driven in firmly at each corner. These should be coloured so as to be easily found on subsequent visits. At least one quadrat should be marked down for each plant association, and where there is considerable divergence within the association two or more quadrats will prove helpful.

The results of the reconnaissance and primary surveys should be carefully written up at home. The reconnaissance map should show the plant associations in the colours used in land utilization maps, viz.: forest, green; arable, brown; permanent grass, pale green; heath, moorland and marsh, yellow; gardens and housing areas, purple; towns, red.

The primary survey map should show more detail in the way of plant societies within the association. For instance, whereas on the reconnaissance map a certain valley with bordering hillsides is all marked as oak forest, on the primary survey map a belt of alders on either side of the stream in the

bottom and a clump of beech trees half way up on the hillside are also shown by appropriate initials or symbols. And where on the reconnaissance map the heathland is marked by its colour symbol, yellow, the primary survey map will show also, by rings marked with the initial letter of the plant, patches of whortleberry, gorse, etc.

Long lists will of necessity accompany the primary survey. These are best made in a loose-leaf notebook so that all studies of each habitat may be kept together.

When the primary survey is made, and notes and maps completed in the neat notebook, the quadrats may be tackled. Squared paper is needed for this, the idea being that each individual plant and the space it occupies should be graphed. This is best done by symbols, a key of which must accompany the neat copy of the map. Quadrats are most instructional when studied at regular, frequent intervals throughout the year. In this way the flowering, seeding, growth, and vegetative reproduction and dying down may be watched, and such problems as reaching for the light and survival of the fittest will be studied first-hand. During Spring and early Summer small seed leaves will appear that are perhaps unfamiliar. As time goes on, however, and the true leaves come, one is able to recognize them—very probably as some quite common plant—but one had never before noticed it in its first stage.

At each visit to the quadrat a fresh map should be made, and the series mounted side by side in the loose-leaf book with notes and comparisons written below for easy reference. One more study may be made to complete the survey of one's island, namely the transect. There are two types of transect, the line and the belt. Let us take the line transect first. Choosing a section of the country passing through a variety of vegetation, one lays down a line, a long measuring tape if possible, or a rope or string knotted or otherwise marked at each yard. Starting at one end and stretching the

line as far as it will reach along the section, you proceed to write in your notebook each plant that grows under or overhanging the line. Where the strata appear, as in woodland, each stratum should be listed separately in columns side by side, showing which plants grow under the shade of which trees.

A diagram may then be drawn to scale at home showing the zones of plant life along the section or transect taken. If this is done over a long distance, the dominants only should be shown, so that the resultant diagram becomes a sectional drawing across the reconnaissance map. The line of this section should be shown on the reconnaissance and primary survey maps.

The belt transect requires two lines, these being placed parallel and one yard apart. The plants are then listed that appear in the belt between the two lines. In this case it is best only to list the species and to say which are dominant, sub-dominant, frequent, etc.

By the time one has completed, conscientiously, all these stages in the survey of one's island, one has probably camped there at least a year! And although one will have learnt much, further problems will have presented themselves requiring at least another five years to solve. And all this suggests that we can't all go off and discover desert islands, even if we wanted to, so what's the good of all this ecological method, anyway?

To make a survey (as outlined above) of a piece of land already familiar may appear rather dull. One will spend much time in listing common plants and deducting principles already long accepted. But once one embarks on a survey, many interesting points crop up and one is surprised that one hadn't noticed more before.

A new abode of Brock the badger was discovered while I was on primary survey work in my own wood; the whereabouts of marsh violets was found whilst making a belt transect. No better preparation for teaching nature study

along ecological lines can be made than by the student or teacher herself making first-hand yearly studies of several types of country, some already familiar, but at least one of a type quite fresh. But the value of the study lies not so much in the actual accumulation of facts gained, as in the scope of such studies applicable to children's work, and the food for thought it provides. One sees the familiar botanical textbook studies in a new light. They really come alive at last! One begins to apply one's botanical knowledge to wider principles than the textbook ever suggested, and one sees living illustrations of every aspect of botany in these simple ecological studies.

In selecting a piece of country for an ecological survey, choose one with natural boundaries rather than one plotted on a map arbitrarily. It is far more in keeping with the subject to study a river valley; a hill, its slopes and crest; a coastal plain; or a valley and the hill slopes on either side, than to rule out a square mile around one's house and set to work to study that, irrespective of the nature of the country. It may be necessary to make some arbitrary boundaries in order to keep the study within sizeable limits, but even then it is better to make a hedge, ditch, stream, or even fence the limit of one's observations. If one can find three or four contrasting types of vegetation within half a mile, that is all that is necessary. It is the contrast that is desirable. This may be given excellently in a valley at the bottom of which is a stream, pond, or marsh, and which slopes up through fields to a wooded hillside; or again, by a stretch of downland up which runs an old lane with high hedge banks, and a circular clump of beech trees on the summit.

The following primary survey shows how ecological interest may be derived from quite ordinary country. It is the type of survey that older juniors should be able to carry out if their previous nature studies have provided them with a sound, working knowledge of the plants of their locality.

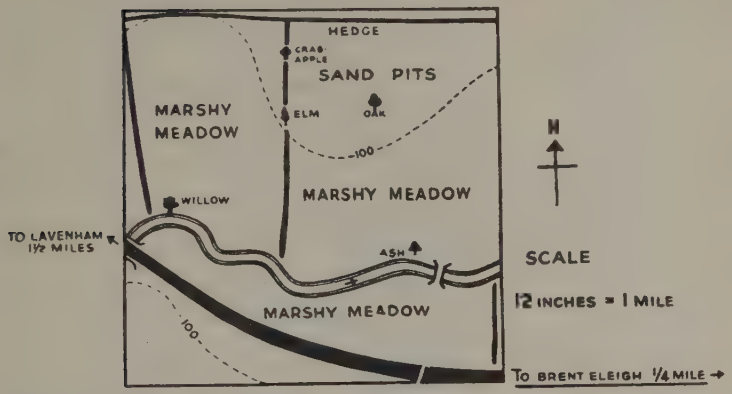


Fig. 12.—*Sketch map of Brent Eleigh Marsh and Meadow where the primary survey was carried out. The boundaries of the survey were formed by hedges on the North and East sides, by the Lavenham to Brent Eleigh road on the South side, and by a short hedge and an arbitrary line across the meadow on the West, approximately where the edge of the map comes.*

## PRIMARY SURVEY OF MARSH AND MEADOW ASSOCIATIONS

### BRENT ELEIGH, W. SUFFOLK

*Date*: September 1–7, 1945.

PHYSIOGRAPHICAL FACTORS — Marshy fields on either side of the River Brett rising from 50 to 100 feet above sea-level. On the north side there is a disused sand-pit.

CLIMATIC FACTORS — Summers moderately warm and dry, winters may be severe.

EDAPHIC FACTORS — The depth of soil in the sand-pits very shallow, and it is light in colour and dry.

The marshy meadow is damp and peaty with a deep, dark soil. In wet seasons this is sometimes flooded.

BIOTIC FACTORS

The river was dredged in 1940 to make a deeper ditch as an obstacle to invasion in the second line of defence of Great Britain. This caused the uprooting of almost all plant life in the river and on its banks, throwing up considerable quantities of mud from the stream bed to the top of the bank. Plant life is now luxuriant. The marshy fields are partly drained, and are in process of being further drained by means of ditches and land-drains.

The sand-pit has been disused for many years. It is grown over with grass and bramble, and rabbits burrow in its sides.

Cattle and horses graze the meadows and pit. Water voles inhabit the river bank, and there are many sticklebacks in the stream.

Birds observed include:—

| | | |
|---|---|---|
| Magpie | Great tit | Snipe |
| Starling | Blue tit | Moorhen |
| Chaffinch | Lesser white-throat | Partridge |
| Goldfinch | | Wood pigeon |
| Linnet | Robin | Stock dove |
| Yellow hammer | Kingfisher | Turtle dove |
| | Little owl | |
| House-sparrow | Heron | |

## PLANT DISTRIBUTION

Four distinct plant associations are apparent, and are listed separately here. It will be noticed that certain plants appear in two or more of the associations.

*Key to initials used in the list*

| | | | |
|---|---|---|---|
| fl. | = in flower | S.D. | = sub-dominant |
| sp. | = species | F. | = frequent |
| D. | = dominant | O. | = occasional |
| | | R. | = rare |

8. *The Study of a Seasonal Quadrat*

(*a*). STREAM BED

No dominant here.

| | | | |
|---|---|---|---|
| Water forget-me-not, fl. | S.D. | Great water plantain | O. |
| Brookline speedwell | S.D. | Water figwort, fl. | O. |
| Water dropwort, fl. | F. | Woody nightshade | O. |
| Water starwort | F. | Gipsywort, fl. | O. |
| Branched bur-reed, fl. | F. | Broad potamogeton | O. |
| Watercress | O. | Common horsetail | O. |
| Three-cleft bur marigold, fl. | O. | Duckweed | O. |
| Capitate mint, fl. | O. | Canadian pondweed | O. |

(*b*). BANKS OF STREAM

Trees:

Willow—one large tree, several small ones

Ash—one large tree

Herbaceous plants:

| | | | |
|---|---|---|---|
| Nettle | D. | Grass sp. | F. |
| Greater willowherb, fl. | S.D. | Upright hedge parsley fl. | O. |
| Hemlock | S.D. | Bramble | O. |
| Marsh thistle, fl. | F. | Wild rose | O. |
| Spear thistle, fl. | F. | Gipsywort, fl. | O. |
| Yellow toadflax, fl. | F. | Fleabane, fl. | O. |
| All heal, fl. | F. | Peachwort, fl. | O. |
| Common horsetail | F. | Water figwort, fl. | O. |
| Meadowsweet, fl. | F. | Water forget-me-not, fl. | O. |
| Teazel, fl. | F. | Lesser willowherb, fl. | O. |
| Marsh ragwort, fl. | F. | Marsh stitchwort, fl. | R. |
| Dock | F. | Square-stemmed St. John's wort, fl. | R. |
| Tansy, fl. | F. | | |

Greater bindweed, fl. R.

(*c*). MARSHY MEADOW

Herbaceous plants:

| | | | |
|---|---|---|---|
| Sedge sp. | D. | Peachwort, fl. | O. |
| Meadowsweet | S.D. | Rush sp. | O. |
| Grass sp. | S.D. | Water forget-me-not | O. |
| Nettle | F. | Greater willowherb | O. |
| Silverweed | F. | Brooklime speedwell | O. |
| Bulbous buttercup | F. | Broad-leaved plantain | O. |
| Common horsetail | F. | Marsh ragwort, fl. | O. |
| Marsh marigold | F. | Capitate mint, fl. | O. |
| Marsh thistle | O. | Ladies' bedstraw, fl. | O. |
| | | Marsh stitchwort, fl. | O. |

(*d*). SAND-PIT

Trees and Shrubs:

| | |
|---|---|
| Oak—one large tree | Hawthorn—several small bushes |
| Crab—one in hedge | Field maple—several small bushes |
| Elm—one in hedge | |

Bramble—several small bushes

Herbaceous plants:

| | | | |
|---|---|---|---|
| Grass sp. | D. | Daisy | F. |
| Ragwort | S.D. | Mouse-ear hawkweed | F. |
| Ribwort plantain | F. | Scentless mayweed, fl. | O. |
| Milfoil | F. | Field woodrush | O. |
| Spear thistle, fl. | F. | White campion, fl. | O. |
| Cudweed, fl. | F. | Wild mignonette | O. |
| Nettle | F. | Chickweed, fl. | O. |
| Ground ivy | F. | Lady's Slipper, fl. | O. |
| Cranesbill, fl. | F. | White bryony, fl. | R. |
| Sheep's sorrel | F. | Woody nightshade | R. |

Fungi:

Spiny puffball. Mushroom.

Looking through the above lists one sees possibilities for many interesting special studies suggested by the creatures found by the way.

The discovery of the kingfisher, snipe, and moorhen by the streamside may well lead to a study being made of water-loving birds and their adaptations to their mode of life. A collection of feathers may be made, with a study of plumage and moulting. The following aspects of botany will almost certainly be studied as a direct result of any plant survey:—

The study of flowering seasons.
Seedlings and the use of cotyledons.
Root systems.
Reaching for the light, and the general growth and adaptations of the plant throughout the yearly cycle.

There is, in fact, no botanical problem that may not come to light through an ecological study.

While bearing in mind the completion of the survey undertaken by the class, time *must* be allowed for these special studies as they arise, for they are the link between ecology and nature study, nay, even biology, and they will encourage the children to make further discoveries on their own initiative.

Older children should also be able to select typical plots and lay down quadrats which they can visit at frequent intervals throughout the year. Some may find accurate charting of individual plants arduous and complicated, and they may keep lists of plants only, noting the dates at which they flower and shed their seeds, and illustrating their lists with careful drawings.

In the study of seasonal quadrats, allow one quadrat to every six or eight children. Three plots of contrasting vegetation will yield sufficient for a year's study. Take plots in which the flowering peaks come at different seasons, and interest will be well sustained. Such plots might be made in

(*a*) a deciduous wood (flowering peak, Spring) (*b*) marsh (flowering peak, early Summer), and (*c*) heath (flowering peak, late Summer).

The heath is an excellent habitat to take in contrast with any others by reason of its dryness, usually high altitude and exposure, and poor soil, pròducing plants of the xrophytic type.

## XEROPHYTES, HYDROPHYTES, MESOPHYTES

On the whole our British vegetation is very mixed and lacking in severe contrasts, so that one finds the same plant growing equally happily in very different habitats. But although our equable climate affords so much freedom to the plants to grow where they will, certain plants are always found in the same habitats and do not wander, and these have become adapted to the mode of life enforced on them by climatic and physiographic conditions. Thus we get the heathers on sandy commons and water-lilies in ponds; the bee orchis on limestone grasslands and the yellow iris in the marsh, and so on. It is those that live in between these contrasting habitats that tend to wander most. One may associate bluebells with sheltered deciduous woods, but they grow even more lusciously on the open cliffs around the coast, and even on rocky islands. Milkwort and tormentil may be found equally flourishing in a low-lying clayey meadow and on a high sandy heath where they form an intermediate stratum between the heather and moss; and the birch tree may be found in a wooded valley or on a windswept hilltop.

While we must avoid labouring the distinction between wet and dry habitats, it is well to know the terms applied to the plants growing consistently in them.

Xerophytes (*xeros* = dry. Greek) are those plants inhabiting dry places. These plants have learnt the dangers of over-evaporation, and such expedients as rolled back leaves with

the stomata hidden in the roll, reduced blade surface, tough cuticles, hairy coverings, succulent stems, low growth and woody stems show themselves in different plants growing in extremely dry places or in salt marshes, where the water content of the soil is largely unsuitable for use by the plant by reason of its salinity. Plants inhabiting a watery home are known as hydrophytes (*hudor*=water. Greek). Their problems are the very opposite of the xerophytes. They keep their stems erect by a constant upward flow of water, causing a state of turgidity, and develop large expanses of leaf-blade to allow the excessive moisture to pass out rapidly. Other hydrophytes develop a mass of smaller leaves—as in the willow—and those growing right in the water may have their stomata on the upper surface of the leaf instead of the lower, as is the convention, in order to reach the air as the leaf floats upon the surface. This is well illustrated by the water-lily. Many are the devices with which plants cope adequately with water, both stagnant and running, but these, along with all details of plant physiology, are adequately dealt with in botanical and biological textbooks, and are beyond the scope of a book of this nature.

In England the larger proportion of plants inhabit a variety of habitats, neither very wet nor very dry. These are known as mesophytes (*mesos*=middle. Greek), and their problems are legion. Chief amongst them in causing peculiarities of growth are, perhaps, the struggle for a place in the light, causing creeping and climbing by various means; and defensive measures against animals, causing the development of thorns and prickles, offensive smell, and poisonous juices.

Much ground has been covered in this and the preceding chapters. It has been lightly stepped over, perhaps, but in a book of this kind it is not possible to linger long over details. Nor is it necessary, for there are many specialized books on all aspects of nature study; and, above all, there is the countryside itself from which to learn.

In nature study we are not aiming at producing naturalists, any more than in art are we aiming at producing artists. Naturalists and artists will emerge, if there, despite our teaching; we need not worry about *them*. The question we should keep ever before us is: are we giving all children opportunities to develop a true appreciation of beauty (including a well-developed critical faculty), an ever-broadening outlook, and an ability and inclination to discover more for themselves?

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CHAPTER XII

# *What For the City Schools?*

SO FAR THIS BOOK has dealt with nature study as it may be sought and taught in rural surroundings. Since the first edition came out, however, so many teachers and students in towns have begged for help that, before publishing the second edition, this chapter has been added.

Obviously the city child has none of the advantages for growing up naturally to an understanding and appreciation of nature that his country cousin has. The aim in teaching nature study in the city therefore needs to be very carefully defined. One should not merely attempt to reproduce the sights and sounds of the country. One should get down to the deep, underlying principles and try to discover a way of satisfying that urge for an understanding of life which it is right all children should possess. This "satiable curiosity" must be satisfied by a different technique in town from that of the country.

What exactly does the town child miss that the country child has? It misses natural beauty of an ever-changing character. It misses the gradual unfolding of the seasons with all that it signifies: birth, life, death, life reborn as it manifests itself in thousands of ways in the country.

But, one might say, there is birth, life and death in the city. The city child sees them in humanity and may know more about them than his slower moving country cousin.

That, I think is the essence of the problem. Where the city child may be plunged direct into the physical and often sordid side of birth, life and death, owing to his living in overcrowded conditions, the country child with space and a

wealth of flowers, birds and animals being born, living and dying around him, comes to a gradual understanding. He may see birth, life and death as something that is beautiful and dignified at its best. What chance has the dweller in tenements of seeing this at its best?

I speak deliberately of "slower moving country child," "gradual unfolding" and "gradual understanding" because this emphasizes something else that is of vital importance.

Nature is never hurried, can never be hurried. To nature time is eternity, eternity time. It is Man who has introduced haste and we are beginning to realize the evils that it brings. Not that speed belongs to the town only. Alas, it is speeding its way into the country also. But nature at any rate is unhurried and constant, and the country dweller cannot escape that.

If, through nature study in the city, we can give the young some realization of the unhurried sureness of nature, of that gradual unfolding year after year, we are giving them a background against which to build their lives and upon which they may rely when man's inventions fail them. Carry this a step further and we call this sureness God.

There is our fundamental aim as applied to present-day needs. How shall we interpret it? As, throughout this book, emphasis has been laid on interest and activity, we must get the children *doing* something about nature in order to experience that feeling of seasonal rhythm.

## GARDENS

By raising flowers from seed the whole cycle of life may be watched, and real beauty brought into the children's lives, as well as the deep satisfaction that comes through contact with the soil.

Wooden boxes or tubs will serve the purpose if there is nowhere to have a real garden border. These boxes may be

obtained from the grocer, but stronger and more permanent ones may be made if wood is available. These should be at least nine inches wide and nine inches deep. Holes must be bored in the bottom for drainage, and the boxes should be raised at least an inch from the ground. Avoid putting them against a north wall, and remember that against any wall they will need constant watering. Boxes should be creosoted inside and painted out. Avoid using colours that will clash with the flowers. It is natural beauty we are trying to produce, not man-made.

From the word "Go" the children should share in the preparation of their gardens. Older children could make the permanent boxes while younger ones bring temporary ones. Everyone can paint them, and nail on supports to strengthen the corners as need arises. Everyone should share in the discussion as to the best position for sun, shade and rain, and all should have some knowledge as to the best kind of earth to use. In this way all will feel they have some responsibility for the success of the gardens.

Few tools are needed. A trowel and a small hand fork are useful. A little rake may be made by nailing nails through a piece of wood so that the points protrude and then attaching it to a handle. Never mind if it does not last for ever. The joy of making is great and may be repeated again and again. An old spoon is invaluable and a child's watering-can indispensable.

The composition of the soil is important as it is necessary that it should be porous and yet as rich as possible in the limited space. I give here the recipe for a good soil given by Anne Ashberry in her fascinating book *Miniature Gardens*:

1 part fibrous loam
½ part coarse sand
1 part leaf mould or moss-peat
½ part grit or fine gravel ¼ inch grade, from which the dust has been removed
A light dusting of bone-meal.

As most annuals like a light soil add more sand if the loam is of a clayey nature.

Put a layer of rubble at the bottom of the box and then add the rest of the soil well mixed.

### WHAT TO GROW

Choose plants that will do much in one season. They should, with young children at least, be grown from seed each spring. Therefore concentrate on annuals. Of the large seeds that are easily examined before sowing one cannot beat nasturtiums. Get mixed colours and the old-fashioned climbing kind rather than the bush varieties, and (this applies to all plants grown for the sake of teaching their life cycle) always grow single ones in preference to double. Double flowers are a product of horticulture, the extra petals being produced at the expense of some or all of the stamens. This means that double flowers do not readily produce seed. By nature flowers are single.

Other annuals that will grow in boxes and small gardens in the city include candytuft, Virginian stock, ten-week stock, clarkia, calendula, love-in-the-mist, but be bold and try any that appeal to the children and are described as hardy in the catalogue. There is a fascination about seed packets with their gay flowers printed on the front, and the children should have an opportunity to examine the packets, and, according to ability, of course, be encouraged to read and to carry out the instructions on them.

There should be no sense of hurry about sowing. Start in good time after the frosts are over; get the soil into a fine tilth and a damp, crumbly (not sticky) consistency, and then follow the directions. Sow the little garden carefully so that the taller plants will come behind the shorter ones. The need for thinning out the seedlings is a law of nature well applied. Nature thins out through the survival of the fittest. In the restricted space of a box garden or flower border we must

thin out the weaker plants to allow room for the stronger ones to develop to the full.

Flowers should be watched for insect visitors, and lessons should be given on the part played by insects in pollination. If no insects appear the flowers will probably become self-pollinated, so that in either case seed production is possible. I have seen self-sown calendulas and snapdragons growing up sturdily around their parent plants in a tiny garden in a playground in Islington. In the same bed a sunflower hung its heavy head and love-in-the-mist had produced its ball-like seed box.

Let the children collect the seeds when they are nearly ripe and dry them off indoors. They should then prepare envelopes for them like the packets they bought in the spring, drawing the flower on the front and writing instructions on the back. The seeds should then be stored away in a cool, dry corner till next spring when the rebirth or new cycle begins.

Vegetables may also be grown—and eaten! Lettuce (Tom Thumb if space is limited), radish, beetroot (globe), turnip, carrot (stump-rooted) and dwarf bean are all reasonably quick growers and each has its particular attraction in shape or colour. If space permits peas, runner beans and vegetable marrows are most rewarding. How well a hedge of runner beans looks against the drab school wall!

Food storage in roots and in the larger seeds is well demonstrated in a garden, while the phenomenon of climbing is illustrated by peas and runner beans. In fact almost all the botanical characteristics of flowering plants may be shown in a small garden if the plants have been well chosen. Moreover seasonal rhythm is there, "in a nutshell." Spring, the time of seed-sowing, summer with its growth to maturity and autumn with the harvesting of seeds and root vegetables. What next? Why, the dead plants are cleared off the garden and put in a tub with earth to rot down ready to manure the soil before sowing next spring! ("Earth to earth.")

Meanwhile, through the dark days of winter our little garden (like so much of nature) sleeps.

Our thoughts become concentrated on indoor occupations and, until the warmer days return, we continue our gardening with indoor bulbs. These demonstrate yet another form of food storage, and to show how early in the year a bulbous plant can start to grow because it has this store, shallots may be set in the little vegetable plot in January or February and their vegetative reproduction watched. Later on onions may be grown from seed to show that bulbous plants have these two methods of reproducing. Much is written on the cultivation of bulbs indoors so that it is superfluous to repeat it here, but I would like to recall the pleasure with which a class in a city school grew its own crocuses (and by the way a crocus is a corm, not a bulb), in ice-cream cartons. Imagine the sight which met the eye of a visitor one drab winter's day when she entered the room and saw the children working at their sums, each with her own crocus flowering on her desk!

To demonstrate the cycle of life in the animal world is much more difficult unless one can keep pets such as mice, rabbits or guinea-pigs. Parental care is demonstrable with these, and as this is such an important lesson to learn, it is of great importance to have these higher forms of life if possible. Insects, such as some of those mentioned in the table on pp. 98–100, may be reared in a town classroom. They give great joy and cultivate in the children the need for care of living things, BUT there is a danger that, if only these lower forms of life are known to the children, they may get a very one-sided idea of reproduction.

Where the country child admires the devotion of birds and thinks the frog "cruel" for ignoring its tadpoles, the study of the lower forms, both in the aquarium and the insect cage, may be all that the town child knows. One would like

children to become aware of the evolution of parental care from the mere survival of the fittest in plants and lower forms of animals, to the devotion to the individual in birds and mammals, culminating in human parenthood.

As the keeping of pets in most schools is fraught with such difficulties as to make it often undesirable to attempt it, every effort should be made to enable children to visit a zoo, or a park where water birds may be seen with their young. Once they have seen a mother animal with its young the time is ripe to show them pictures of others they cannot see, and to discuss the matter freely.

Other studies, such as weather and the sky, are possible in varying detail according to age, and in any case weather records should be kept in connection with gardening. Older juniors could make detailed studies of one or two birds, notably the sparrow and the pigeon. The homing instinct (akin to migration) formed a project in one school in which the children borrowed a pigeon from a town ninety miles away and safely set it on its homeward way. This was linked on to geography as nature so often may be. Studies may also be made, with the help of books, pictures, museums and zoos, of animal life in other lands, with special reference to adaptation to environment.

Of necessity this chapter can only point the way. Of the difficulties that beset the way I am only too aware: over-heated classrooms left cold and deserted each week-end; of lack of earth, lack of money; of other people using the same premises. These difficulties can only be surmounted by those who know the local conditions and are determined to win. The best armour in which a teacher can fight is enthusiasm and a knowledge of her subject. She *must* know the lessons she can draw from the material to hand. She must miss no opportunities. There are many ways of gaining this knowledge: periodicals for gardeners and naturalists, B.B.C. talks,

museums and natural history societies, and the country itself not so very far away.

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